

Capacity Building workshop Construction of gas based tunnel kiln

22nd March 2018 at Khurja

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



Table of contents

WORKSHOP SUMMARY.....	1
Overview of training programme.....	1
Summary of points discussed in the meeting.....	1
Feedback forms.....	2
Suggestions by participants.....	3
Learnings by participants.....	3
ANNEXURE 1: AGENDA OF THE PROGRAM.....	7
ANNEXURE 2: LIST OF PARTICIPANTS.....	9
ANNEXURE 3: SELECTED PHOTOGRAPHS OF THE EVENT.....	17
ANNEXURE 4: SAMPLE FEEDBACK FORMS.....	19
ANNEXURE 5: COPY OF PRESENTATIONS.....	25

Workshop summary

Overview of training programme

The 3rd capacity building workshop of local service providers (LSPs) on “Construction of gas based tunnel kiln” was organized at Khurja by TERI on 22nd March 2018, in association with the Central Glass and Ceramic Research Institute (CGCRI) under the GEF-UNIDO-BEE project. A total of 49 people participated in the training programme. A field visit to a ceramic unit in the cluster was organised after completing of the training programme. The agenda of the training programme and the list of participants are enclosed as annexure 1 and annexure 2 respectively.

Summary of points discussed in the meeting

Dr K C Singh, CGCRI (Khurja) welcomed the participants and thanked UNIDO and TERI for organising the series of capacity building workshops relevant for Khurja ceramic cluster. He summarised that both training programs were quite useful for different LSPs who were closely involved at various levels. The first programme focused on needs to build capacities of LSPs while switching over to oil firing to gas firing in which both energy and safety issues are more important. The 2nd training programme focused on how to build energy conservation measures and providing solutions related to energy efficient technologies for the ceramic units. He hoped that the 3rd training program would be more useful as there is a need to adopt energy efficient tunnel kilns to compete with the market and sustainability of the units.

On his opening remarks, Mr N Vasudevan, TERI reminded all participants that change is a recurring process. Over a period of time, the local ceramic units had shifted from inefficient and more polluting coal-fired downdraft (DD) kilns to tunnel kiln technology. However, studies pertaining to energy efficiency at the cluster level clearly indicate that there is a wide scope for enhancing energy efficiency. He further added that the Detailed Project Reports (DPRs) which would be prepared under the ongoing project on different identified energy efficient technologies would be useful for the cluster in technology up gradation.

Mr Ananda Mohan Ghosh, TERI made a presentation on various features involved in construction of a gas based tunnel kiln. Mr Ghosh explained about different energy efficiency options available while constructing gas based tunnel kilns. While adopting gas based tunnel kilns, the units should pay adequate attention towards safety issues. He added that monitoring of temperatures in different zones (preheating, firing and cooling) are important and adequate measuring points should be added in these zones which could be linked with auto control system for deciding the push rate of cars for different product profiles and ensure minimum rejections. Mr Ghosh presented the need for adopting low thermal mass cars and kiln furniture which would help in enhancing production rates. He further added the importance of use of insulation requirements in different zones (e.g. hot face and cold face insulation) suitable burners for gas firing.

Mr Vikas Bhardwaj, Murugappa Morgan Thermal Ceramics Limited, Delhi provided an overview of different insulation types such as folded ceramic fibre blanket, pyro block, super wool insulation, etc. used for various insulation applications. He added that the industry should use compatible insulation products suitable for a specific application that would ensure optimum insulation resulting minimum heat losses from skin surfaces of the firing kiln. He also stressed about use of hot face painting to avoid early failure of insulating arrangement. Finally, he explained the cause and effects for a typical energy balance

“Sankey diagram’ of a kiln and discussed about compatible insulation to be employed for different high temperature zone. He discussed the use of thermography to identify localised hot spot due to damage of existing insulation and planned corrective maintenance as needed.

Mr Sharafat, tunnel kiln fabricator in Khurja cluster talked about latest design of long-tunnel kilns that use low thermal mass (LTM) cars. He explained that use of LTM can reduce product to dead weight ratio to 1:1 against the existing 1: 3. The reduction in deadweight would help in enhancing the production by two-fold as the push-time of car would reduce to about 15-20 minutes against the existing 45-50 minutes. Apart from improvement in productivities, new design is equipped with better safety measures and there will be significant reduction in maintenance costs.

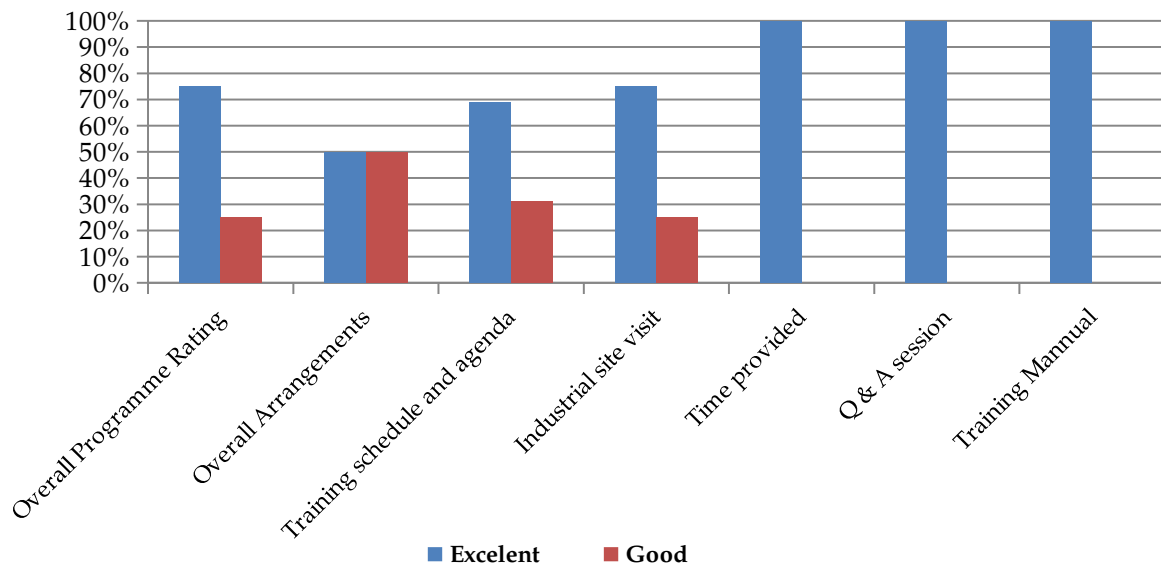
Mr Prasant Panwar, Solar Pulse Energy, Delhi provided an overview of electricity production in the premises of ceramic units using solar photo voltaic (SPV) systems and the benefits of net metering and accelerated depreciation available for such projects.

Dr L K Sharma, CGCRI in his presentation reiterated the need for high end refractory material such as cordite in place of conventional saggars. He added that CGCRI provides technical guidance to ceramic units in adopting ultra-low thermal mass material in reducing deadweight of kiln cars. CGCRI has supported about 20 ceramic units for using ultra low thermal mass cars. He stressed the industries to install compatible burners supplied by reputed suppliers, use of high quality insulation material and install adequate temperature monitoring systems, which will be useful as the industry is in a transition to shift to natural gas as fuel for tunnel kiln. Dr K C Singh thanked all the participants for participating in the training program.

A field visit was organised by TERI to Maya Industries, which uses traditional shuttle kiln for firing their products. The participants were shown the existing system and told the data monitoring gap due to lack of instrument in place. Participants took part to identify potential options and briefed the entrepreneur about potential changes can be introduce to reduce energy cost in the process. Selected photos of the workshop are provided with the annexure 3.

Feedback forms

Based on the analysis of the feedback forms received from the participants, it was observed that workshop was well received by the participants and 100% participants were satisfied with ceramic visit, Q&A session and training module provided to them. About 75% participants have rated overall program as “Excellent” while rest of them have rated it as “Good”. More than 65% 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) More awareness on ultra-low thermal mass cars
- 2) Demonstration of SPVs

Learnings by participants

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

- 1) Design and operation Long tunnel kilns
- 2) Use of rooftop SPVs

Annexures

Annexure 1: Agenda of the program



Capacity building workshop

Construction of gas based tunnel kiln

Thursday, 22nd March 2018

Conference Hall, CGCRI, Khurja ceramic Cluster

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Agenda

10:00 – 10:30	Registration
10:30 – 10:35	Welcome Address Dr K C Singh, Central Glass and Ceramic Research Institute
10:35 – 10:40	Opening Remarks Mr N Vasudevan, TERI, New Delhi
10:40 – 11:00	Best practices in kiln construction Mr Ananda Mohan Ghosh, TERI
11:00-11:45	Compatible ceramic insulation material for kiln construction Mr Vikas Bhardwaj, Murugappa Morgan Thermal Ceramics Ltd, Delhi
11:45-12:15	Solar system for power generation Mr Prashant Parmar, Solar Pulse Energy, Delhi
12:15 – 12:45	Fabrication of fast push tunnel kiln Mohd Sharafat Ali, Tunnel kiln fabricator, Khurja
12.45 – 13:30	Use of insulating refractories in kiln construction Dr Lalit Kumar Sharma, Central Glass and Ceramic Research Institute
13.00 – 13:30	Q&A
13:30-14:30	Lunch
14:30 – 16:00	Site Visit / On-site training Visit to a pottery unit, Khurja
16.00 – 16:30	Feedback from participants
16:30 – 16:40	Vote of thanks Dr K C Singh, Central Glass and Ceramic Research Institute

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Annexure 2: List of participants

S. No	Name	Organization	Mobile No	Email ID
1.	M Shamshad	J K Engg. Works	9837268274	Jkenggworks0786@gmail.com
2.	Prashant Rana	Solar Pulse Energy	9599549403	prashant@solarpulseenergy.com
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4.	Viresh Chandra	Technical Advisor	9639010425	
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15.	Abdul Karim	Khurja	9917713322	
16.	Dharmendra Singh	Khurja CGCRI	9045927626	
17.	Raju Kumar	Rajeev Pottery	9870798791	
18.	Prakash Prasad	Rajeev Pottery	7895905284	
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28.	Nirmal Suman	CGCRI	9837845476	
29.	Amar Jeet	CGCRI	7417833393	
30.	Raju	Raj Engineering	9719196175	
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35.	Virendra P	Patra Ceramics	7417176074	
36.	Sunil Kumar	Rahul Ceramics	9837556562	
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40.	Sameer Ullah Khan	Anas Engineering	9837758482	
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42.	Nadeem	Sunshine Pottery	9897850764	
43.	Umar Malik	Roshni Pottery	9152179677	
44.	Parag	Minhas Pottery	8273237095	
45.	Ajal Singh	UNIDO	8980371090	
46.	Shakeel Ahmed	Geo Industries	9037094402	geoindustries@gmail.com
47.	Vandna Sharma		7078558874	



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49.	L K Sharma	CGCRI	9810044600	

Capacity building workshop
Construction of gas based tunnel kiln

22nd March 2018, Conference Hall, CGCRI, Khurja ceramic cluster

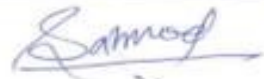

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14	MUHAMMED ASHRAF	ROYAL CERAMIC IND	9897481761		
15	Bhaskar Mishra	AGC	9917713322		
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21	प्रवीण	एन एन	9897159787	Pr	
22	Vikas Bhardwaj	Morgan	9582797927	Vikas.Bhardwaj@morganplc.com	Vikas
23	M.R.PONDHAN	Morgan	9840909452	Ramaswamy.Gondiyar@morganplc.com	M.R.P.
24	GANTAM BANGCHI	Morgan	9910027893	gantam.bangchi@morganplc.com	G. Bangchi
25	Ram Singh	CCERI	7310716143		Ram Singh
26	Ravi Shankar Aji	CCERI	9045373457		Ravi Shankar
27	अमर	किंग टिस्ट	9219718164		

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31	अशोक अमर सिंह	राज इंजीनियरिंग	9410673754		अशोक अमर
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35	Vijayendra Pandey	Partners Ceramics	7417176074		Vijayendra
36	सुनील कुमार	राहुल सिरेमिक्स	9837556562		सुनील कुमार
37	Arjeesh Singh	C.G.C.R.I.	8859253323		Arjeesh Singh

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39	अनिमल झा	Anand Engineering	9837510606		अनिमल झा
40	अनिमल झा	Anurag	9837758482		Anurag
41	Santosh Kumar	Bihar Ceramics	9897545707	SANTOSH.K.1982@gmail.com	Santosh
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43	Umar Malik	Rishni Pottery	9152179677		Umar Malik
44	PARAS	MINHAS POTTERY	8273237095		Paras
45	Ajeet Singh	UNIDO	8980371090	cl.khujis cluster@gmail.com	Ajeet Singh

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49.	Dr L K Sharma	CACRI	981004400		
50.					
51.					
52.					

Annexure 3: Selected photographs of the event



Annexure 4: Sample feedback forms



Capacity building workshop
Construction of gas based tunnel kiln

Thursday, 22nd March 2018

Conference Hall, CGCRI, Khurja ceramic Cluster

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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 []	
Suggestions & Recommendations for improvement:			
Cased			
Name two learning, which from this programme you will be able to implement in your plant?			
yes			
Signature: <i>[Signature]</i>			
Name of participant: <i>Zahiruddin</i>			
Organization: <i>maya industries</i>			
Mobile No: <i>9358607495</i>			
Email ID: <i>zahirv059@gmail.com</i>			

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Capacity building workshop
Construction of gas based tunnel kiln

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Conference Hall, CGCRI, Khurja ceramic Cluster

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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:			
इस तरह के कार्यक्रम समय-समय पर करना चाहिए			
Name two learning, which from this programme you will be able to implement in your plant?			
Signature: <i>Vishesh chandni</i>			
Name of participant: <i>Vishesh chandni</i>			
Organization:			
Mobile No: <i>9639010435</i>			
Email ID:			

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Capacity building workshop
Construction of gas based tunnel kiln

Thursday, 22nd March 2018

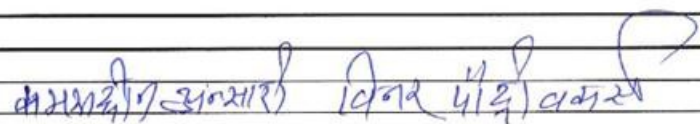
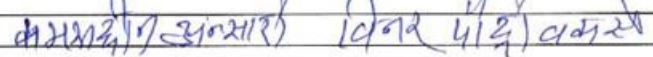
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Evaluation Sheet for Participants

Feedback Form for Participants			
Parameter	Feedback		
	Excellent	Good	Average
How would you rate the overall programme?	<input checked="" type="checkbox"/>		
How would you rate overall arrangements?	<input checked="" type="checkbox"/>		
How was the training schedule and agenda?		<input checked="" type="checkbox"/>	
How was the industrial site visit?		<input checked="" type="checkbox"/>	
Do you think that adequate time was provided for each topic?	Yes [] <input checked="" type="checkbox"/>	No []	
Do you think that satisfactory answers were given to your questions during the training programme?	Yes [] <input checked="" type="checkbox"/>	No []	
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Suggestions & Recommendations for improvement:			
Name two learning, which from this programme you will be able to implement in your plant?			
Signature: 			
Name of participant: 			
Organization:			
Mobile No:			
Email ID:			

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How was the training schedule and agenda?		<input checked="" type="checkbox"/>	
How was the industrial site visit?		<input checked="" type="checkbox"/>	
Do you think that adequate time was provided for each topic?	Yes <input checked="" type="checkbox"/>	No []	
Do you think that satisfactory answers were given to your questions during the training programme?	Yes <input checked="" type="checkbox"/>	No []	
Do you think that the background training manual is informative and useful enough?	Yes <input checked="" type="checkbox"/>	No []	
Do you think that the discussion on EE/RE will help you in your work?	Yes <input checked="" type="checkbox"/>	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>[Name]</i>			
Organization:			
Mobile No: <i>7895905284</i>			
Email ID:			

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Annexure 5: Copy of presentations



Capacity Building of Local Service Providers (LSPs) Energy conservation

Mr. Ananda Mohan Ghosh, TERI

Mr. N Vasudevan, TERI

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Promoting Energy Efficiency and Renewable Energy in selected MSME
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About TERI

- ❑ Not-for-profit, independent, research institute, established in 1974
- ❑ Head office in New Delhi. Regional offices: Bangalore, Mumbai, Guwahati, Mukteshwar and Goa
- ❑ Staff strength of over 1,000
- ❑ Industrial Energy Efficiency Division of TERI focuses on energy efficiency in industry sector including MSMEs



About Khurja pottery cluster

- ❑ No of units: > 250
- ❑ Product material: stoneware and bone china
- ❑ Primary products:
 - table wares, decorative wares, and porcelain insulators(both HT - high tension and LT -low tension), hospital ware, chemical porcelain, electro ceramics, kiln furniture, special ceramics, toys and non-china crockery products.



Development in firing kilns

Type	Mode of operation	Fuel used
Down draft (DD)	Batch	Coal
Shuttle kiln	Batch	light diesel oil (LDO) and rubber processed oil (RPO)
Tunnel kiln	continuous	light diesel oil (LDO) and rubber processed oil (RPO)
Tunnel kiln	continuous	Natural gas

Evolution:

- ❑ Shift towards batch to continuous process,
- ❑ Adoption of cleaner fuel (coal to gas)



Parts of NG based tunnel kiln

- Refractory lining
- Kiln insulation
- Rails for car movement
- Instrumentation (sensor and indicator)
- Gas train
- Air train



View of NG based tunnel kiln

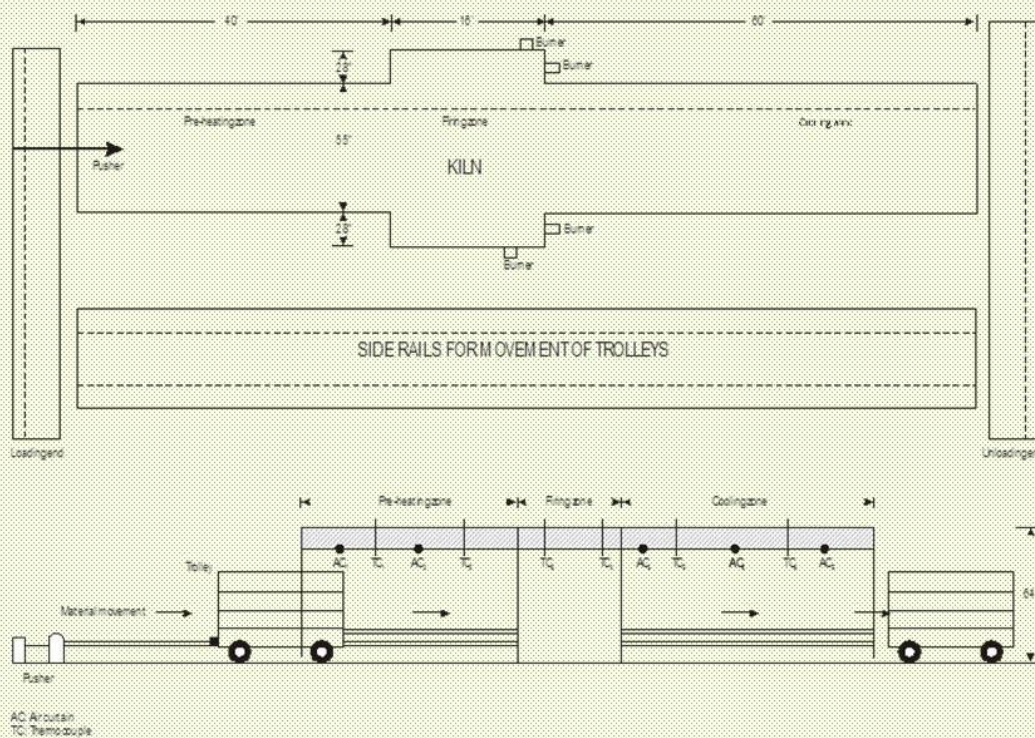


Typical dimensions of tunnel kiln

Zone	Length (metre)
Exhaust area	3
Preheating zone	12
Firing zone	6
Rapid cooling zone	3
Slow cooling zone	8
Cooling to ambient	3
Total	35



View of dimensions of tunnel kiln



Temperature indicators and sensors

Item	Type	Specifications
Sensor	Type K	Temperature range : 0 - 1370°C Material: aluminium–chromium
Crown sensor	R-type	Temperature range : 0–1760 °C Material: Pt (87%)–Rh (13%) (platinum–rhodium)
Digital indicator	Multi-channel	Display: 4 digit (absolute figure) Resolution: 1 °C
Digital indicator	Stand-alone	Display: 4 digit (absolute figure) Resolution: 1°C
Miscellaneous	Cable	Compatible compensating cable for electrical connection



Important meters and safety devices

- Gas/oil flow meter:** monitor consumption of gas/oil in kilns
- Air flow meter:** monitor and control air flow to ensure proper air to fuel ratio
- Oxygen analyser:** monitoring O₂ (oxygen) content in flue gases
- On-line temperature indicators:** monitor and displays temperature
- Non-contact temperature indicators:** useful to measure surface temperatures and heat losses.

Safety shut-off valve	Type: pneumatic with flame-proof enclosure
	Size: 50 mm NB; operating fluid—natural gas; valve orientation—horizontal
	Three operating conditions: <ol style="list-style-type: none"> 1. Low pressure e.g. 200 mm WC 2. High pressure e.g. 1200 mm WC 3. Electrical power failure during operation



Preheating of new kiln

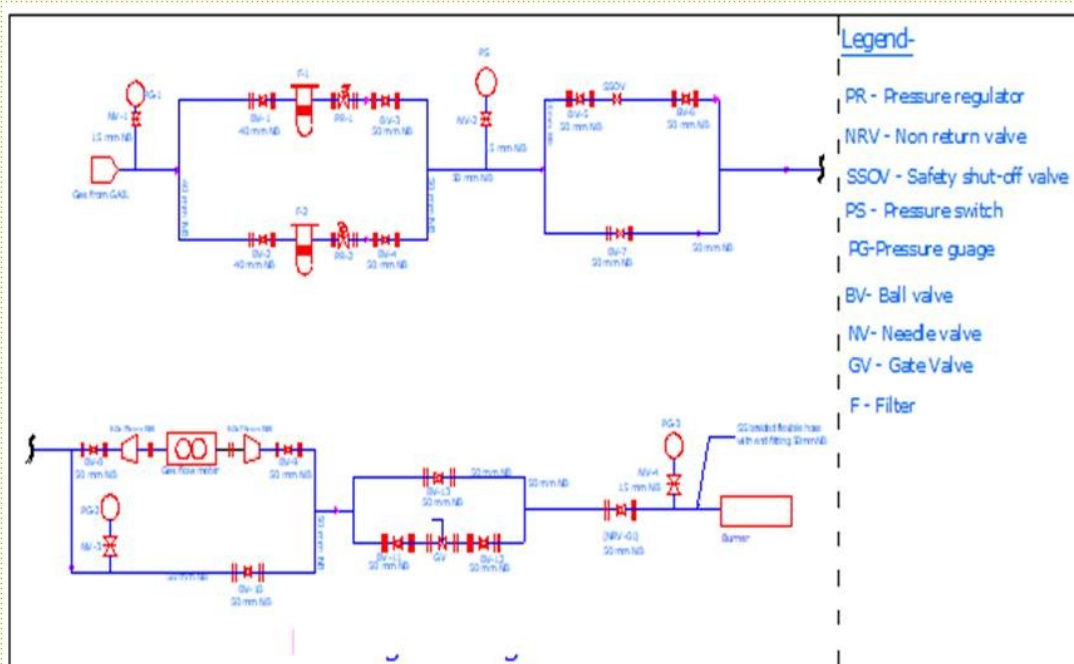
Kiln temp. (°C)	Rate (°C /hr)	Duration (hr)	Cumulative (hours)
Up to 100	4	25	25
100–220	3	40	65
220–500	6	47	112
500–750	4	63	175
750–1200 (+)	10	45	220

Alternate Schedule (~10 days):

- **Stage 1.** attain 750 °C @ around 4° C per hour (up to 100° C /day~8 days)
- **Stage 2.** reach 12000°C @ around 10° C per hour (up to 240° C /day~2 days)



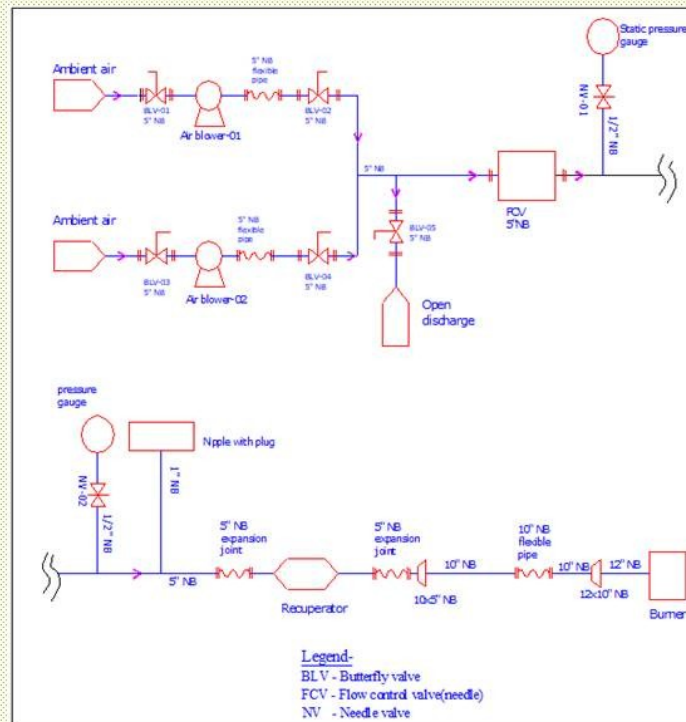
Gas train – schematic view



Air train – schematic view

Air train components:

- ID/ FD blowers
- Pressure gauge
- Air flow meter
- Control valves
- By-pass lines



BOPs for gas based kiln

Area	Target	Approach	Benefits
Kiln top and side walls	Reduction of average surface temperature	Routine measurement of surface temperature	Potential scope to reduce NG consumption
		Improve insulation	Low workplace temperature
Kiln internal temperature	Maintain optimum temperature	Monitor kiln temperature at regular interval Gradually control gas and air flows	Achievement of optimum gas consumption
Excess air flow	Maintain optimum air-fuel ratio for complete combustion	Routine monitoring of oxygen level in flue gas	Reduction in flue gas losses
Kiln furniture	Kiln cars	Low thermal mass cars	Increased productivity



Troubleshooting for gas based kiln

K-1

Temperature variations within the kiln

- Incorrect burner fitment
- Improper sizing or location or partial blocking of flue path
- Incorrect draught within the furnace

- ✓ Burner installation – should be such that combustion products gets evenly distributed in the entire firing chamber
- ✓ Clear blocking of flue path.
- ✓ Furnace draught – Adjust for positive pressure using the damper near the chimney.

teri

Troubleshooting for gas based kiln

K-3

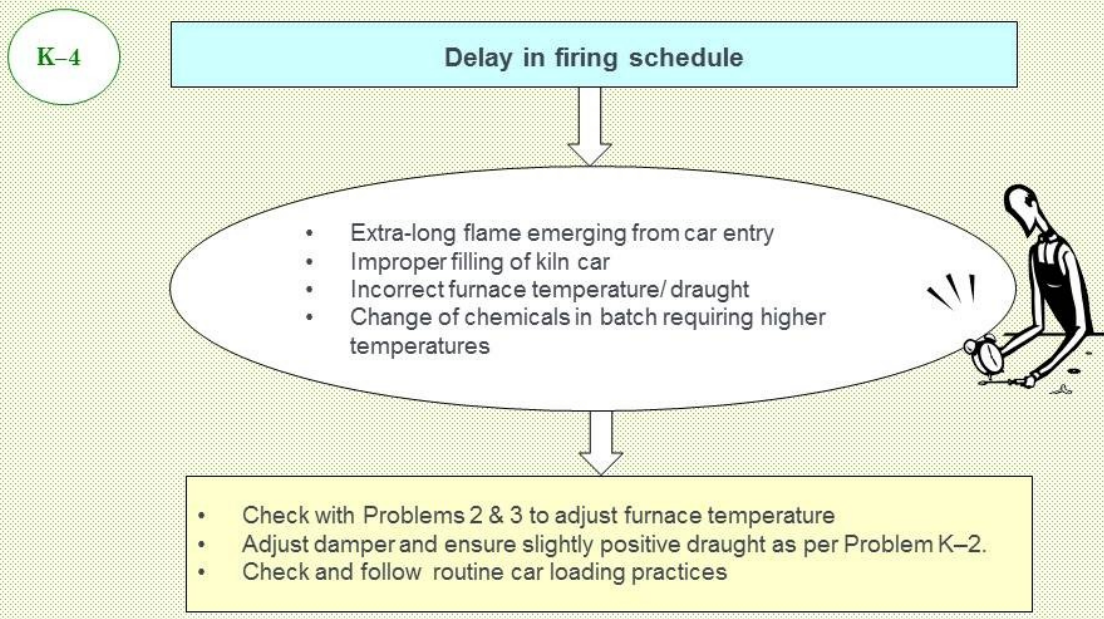
Incorrect kiln temperature

- Faulty temperature indicator
- Improper furnace draught
- Incorrect air and gas flow

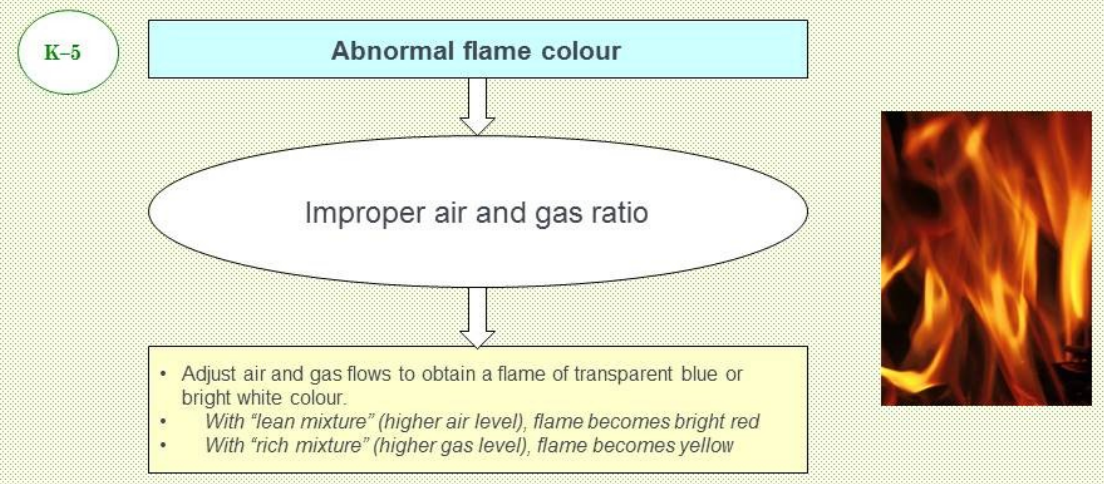
- Cross check temperature indicator. Use different indicator/ compensating cable. Repair/ replace the faulty meter.
- Ensure slightly positive furnace draught. You will observe furnace temperature start rising immediately.
- Slowly increase gas and air flows. Maintaining pre-set air to gas ratio. Re-adjust the furnace draught.

teri

Troubleshooting for gas based kiln



Troubleshooting for gas based kiln



Troubleshooting for gas based kiln

G-3

Incorrect reading of gas flow meter

- Gas flow meter not installed as per supplier's instructions.
- Absence of earthing wire in electrical power connection
- Flow meter is due for calibration/ maintenance
- Flow meter is not properly calibrated maintenance

- Ensure proper installation of gas flow meter according to the supplier's instructions
- Check power connection including earthing
- Consult the supplier for guidance/ repair



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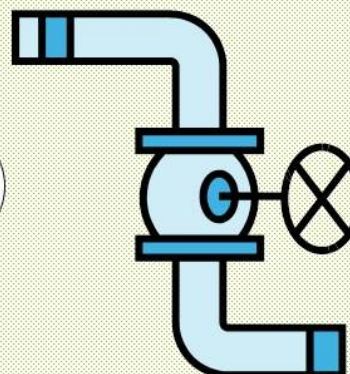
Troubleshooting for gas based kiln

G-4

High pressure drop in gas line

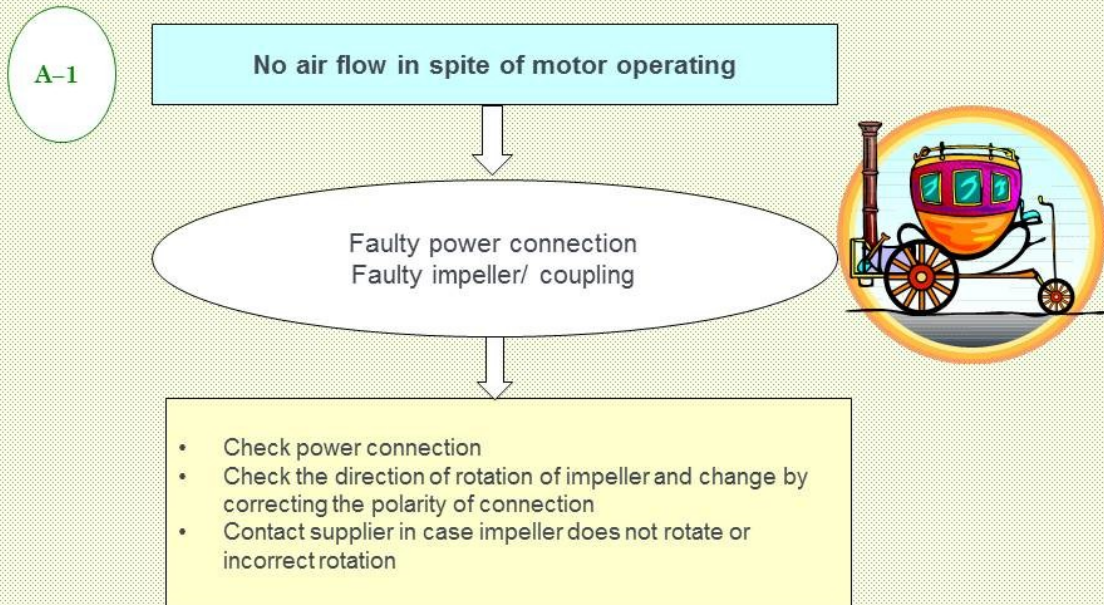
- Improper functioning of Pressure Reducing Valve (PRV)
- Higher resistance of gas piping due to burrs, choking and improper lining
- Leakage from joints/flange/welding points

- Check PRV with a calibrated pressure gauge for proper functioning. If required, reset or repair PRV
- Carry out leak test, check for choking or blockage in gas line



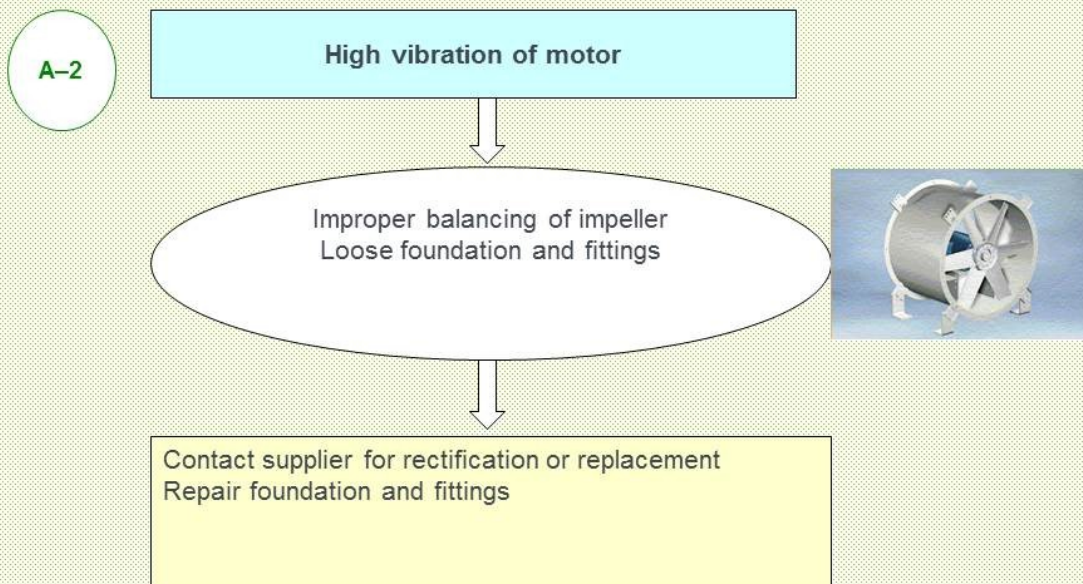
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Troubleshooting for gas based kiln



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Troubleshooting for gas based kiln



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Troubleshooting for gas based kiln

A-4

Incorrect reading of air flow meter

- Suppliers' instruction not followed during installation of air flow meter
- Improper power connection/ earthing
- Improper calibration of air flow meter
- Air flow meter is due for scheduled maintenance

- Ensure installation of air flow meter as per supplier's instructions
- Correct power connection/grounding
- Calibrate air flow meter
- Contact supplier for repair and maintenance



teri

Thank you

teri

Compatible ceramic insulation material for kiln construction(Insulation)

Murugappa Morgan Thermal Ceramics Limited
Vikas Bhardwaj

www.morganadvancedmaterials.com

About Murugappa Group

- **Murugappa Group**- one of the most respected Business House in the country
 - Rs 32000 Cr Multi-business conglomerate
 - Abrasives, Refractories, Tubes, Bicycles, Fertilizer, Plantation, Financial Services, Construction, etc
 - MMTCL is Joint venture company between Morgan Crucible of UK (51% equity) and Carborundum Universal Ltd. (49% equity) of Murugappa Group.

MMTCL- Highlights...

- Leaders in high temperature insulation. Introduced several new products & developed many application solutions.
- Thirty years old company, first Ceramic Fiber Plant in India , largest capacity.
- Largest market share in the country
- Significant players in Passive Fire Protection and Asbestos Replacement
- World class manufacturing facilities at Ranipet (TN) & Moti Bhoyan (Gujarat)
- ISO-9001 and 14001 certified



MMTCL's Vision

Leader in Advanced Thermal Solutions

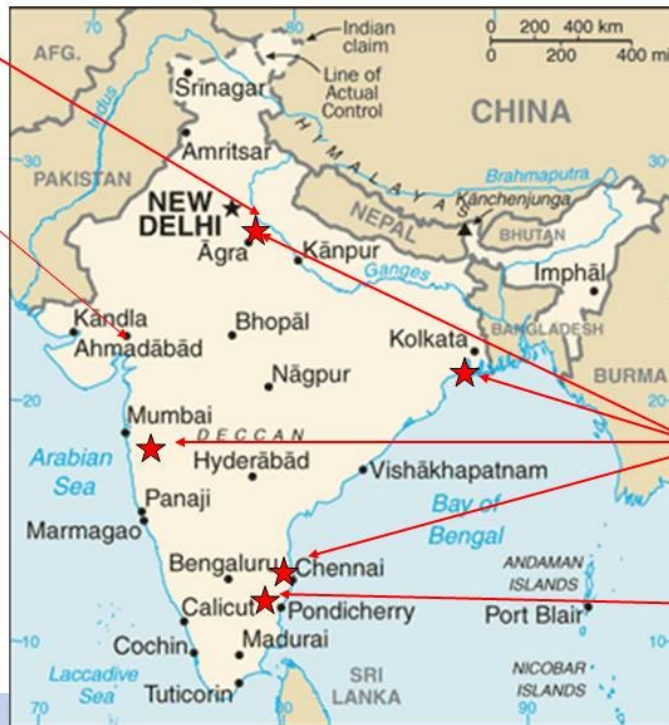


MMTCL – Indian Operations



Ciria India Engineering Office Noida, Delhi

Moti Bhoyan Plant Gujarat



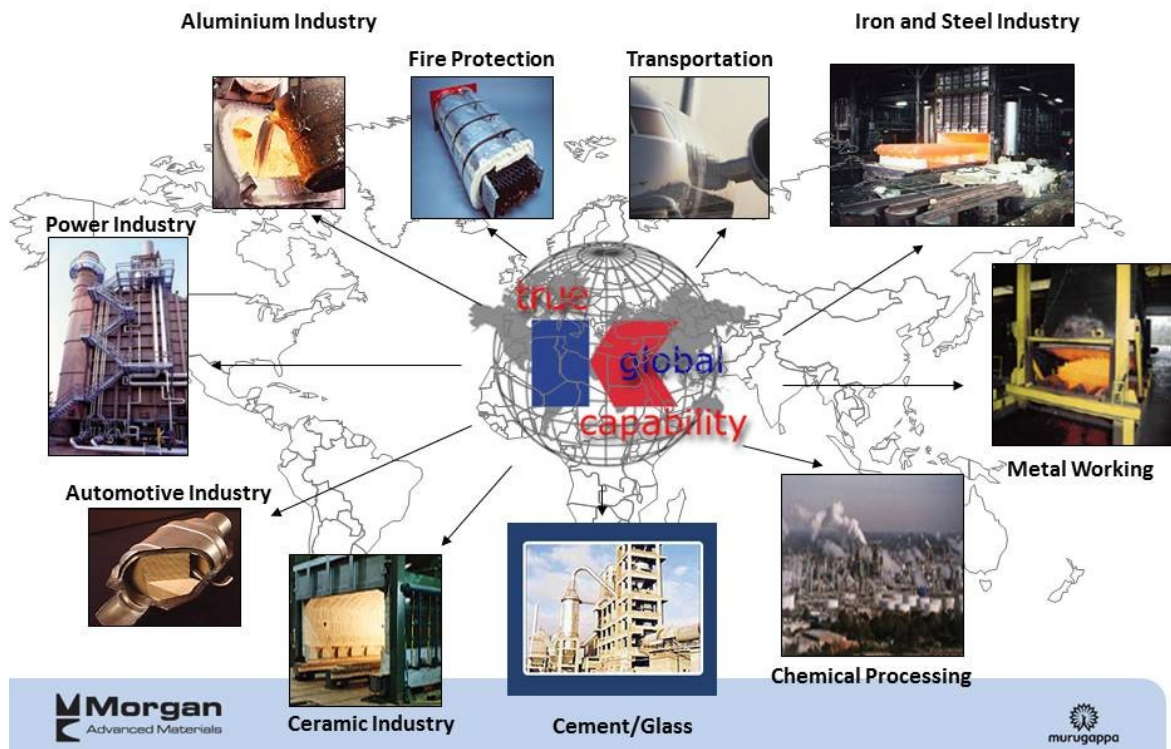
Sales offices in Kolkata, Chennai Delhi and Mumbai

Ranipet Plant 120 Km from Chennai



6

Our Key Markets



About Ceramic Fibre

- Ceramic fibre is man made inorganic refractory fibre
- Types of Ceramic fibre :
 - **RCF (Refractory Ceramic Fibre)/Alumino Silicate fibres** : $<60\% \text{Al}_2\text{O}_3 + \text{SiO}_2 + \text{ZrO}_2$. Amorphous/Vitreous Form. Service Temp : up to 1425 Deg C
 - **AES Fibre(Alkaline Earth Silicate fibres)** : $\text{CaO} + \text{MgO} + \text{SiO}_2$. Amorphous / Vitreous form. low bio-persistence – Up 1300 Deg C.- Super Wool
 - **Poly crystalline fibres /Aluminium Oxide fibres** : $>60\% \text{Al}_2\text{O}_3 + \text{SiO}_2$ / Mullite Form/ Temp : Up to 1600 Deg C.
- Manufacturing process is different for making different fibres.



Product Range

Bulk Fiber



Blankets

Vacuum Formed Boards



Paper



Ceramic fibre Textile products



Modules-Folded & Pyroblocs



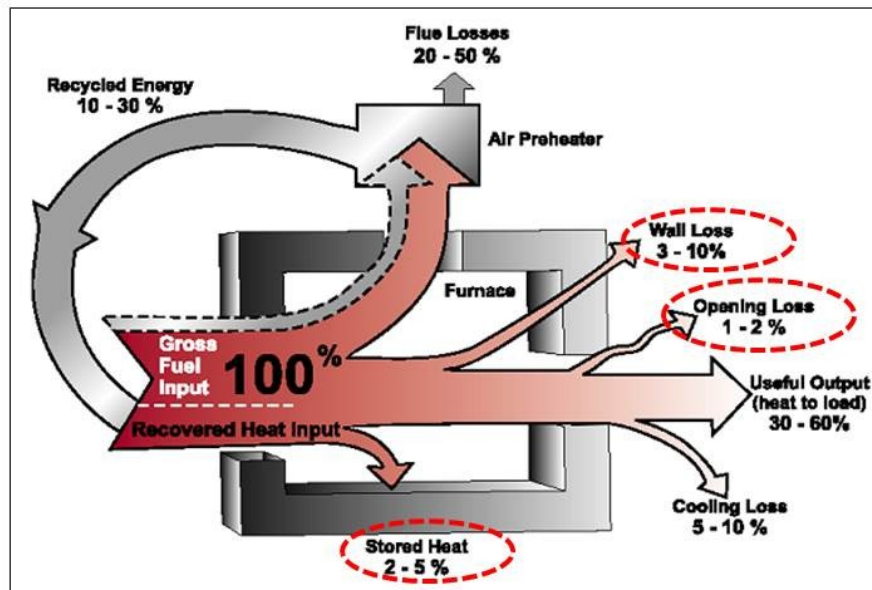
Folded modules



Pyroblocs



Heat balance of Kilns



Module LINING SYSTEMS

End Mounted

- Saber Bloc
- Z blok III

Center Mounted

- Pyrofold M module
- Z blok
- Saber bloc III
- Pyrobloc M Module

Others

- Monolithic (Monomax)



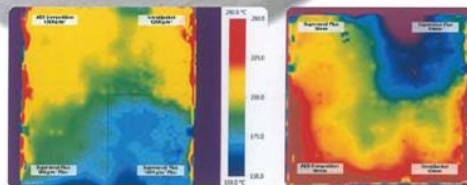
Present Lining Design

- **Three Zones- Pre Heating, Heating & Cooling Zone**
- **Min 4 Inch to Max 12 Inch**
- **Max Operating Temp – Around 1150- 1200 Degc**
- **Presently using Site made Folded Modules**
- **Fuel-Light oil**



Super Wool Plus- Next Gen product

Superwool® Plus™ fibre is the most energy efficient fibrous insulation material; it can reduce energy losses without occupying more space or using increased mass. Maintenance of your furnace lining and insulation system can result in significant energy savings. In many cases, the extra cost of more efficient lining materials can be recouped within a year or two. Maintaining the lining in your furnace and making the recommended and necessary changes enables you and your business to reduce energy waste and improve operating efficiencies and process consistency.



Properties of Super Wool Plus Blanket

- ❑ Reduces thermal conductivity and energy loss: improved insulation by 20%
- ❑ Less shot: cleaner workspace, less skin irritation
- ❑ Strong with good handle ability: ease of installation saving time and waste
- ❑ Provides significant energy savings compared to other tested AES and RCF fibres
- ❑ Minimises the weight and thickness of the insulation layer saving up to 25% in material
- ❑ Improved handling: operator satisfaction

Superwool plus vs RCF Blanket

Properties	Superwool Plus		Cerablanket	
	128 kg/m ³	96 kg/m ³	128 kg/m ³	96 kg/m ³
a. Thermal Conductivity, W/mk, @ mean temperature (ASTM C – 201)				
400 C	0.08	0.09	0.10	0.11
600 C	0.12	0.14	0.15	0.16
800 C	0.18	0.21	0.20	0.23
1000 C	0.25	0.29	0.27	0.32
b. Behavior under Furnace atmosphere *	Reaction starts at this temperature			
i. Mo/MoO ₃	800 C		800 C	
ii. Zn/ZnO,	1000 C		1150 C	
iii. Cu/CuO	1000 C		1100 C	
iv. B ₂ O ₃	700 C		1100 C	
v. K ₂ CO ₃	900 C		900 C	
vi. Na ₂ CO ₃ , Pb/PbO	800 C		900 C, 800 C	
vii. P ₂ O ₅	700 C		700 C	
viii. V ₂ O ₅	900 C		1150 C	
c. Chemical Composition, %				
i. CaO	26 – 32			
ii. MgO	3 - 7			
iii. SiO ₂	62 - 68		54 - 58	
iv. Al ₂ O ₃			42 - 46	
v. Fe ₂ O ₃	< 1		0.1	
vi. Na ₂ O+K ₂ O				

Super wool properties

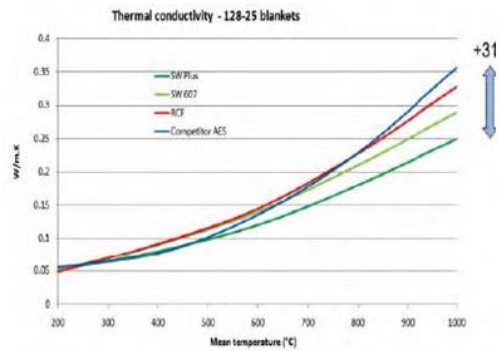
d.	Shot Content (> 45 μm), %	< 38		< 55	
e.	Resiliency, %	85		80	
f.	Fibre Index, %	Min 60		Min 50	
g.	Tensile Strength, (kgf/m ₂)	5000	4000	6000	4500
h.	Continuous Use Temperature, C	1000		1150	

Features of Superwool Plus :

- a. Lower thermal Conductivity by 20% compared to Cera of same density.
- b. 20 - 30 % more fibres compared to RCF Blankets.
- c. An environmental non-hazardous solution

Benefits of using Superwool Plus:

- a. Exonerated from carcinogenic category
- b. Energy Saving up to 17%
- c. Lower Density grade insulation for the same result.
- d. Better cost saving solution



* Elements like Nickel, Tin, Manganese, Chromium, Iron and their oxides will have no reaction at continuous use temperature for Superwool Plus grad materials. Cera Blanket is highly resistant to Sulphur acid, where as Sulphur and HF will produce a strong attack on Superwool Plus Material. A combination of contaminates will worsen the chemical attack.



Sw 607 Modules & Pyro Modules



Sw 607 Board



Sw 607 Bulk (Superpak)



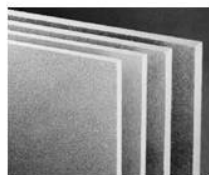
Sw 607 Blanket



Sw 607 Paper



Sw 607 Felt



Sw 607 Blok



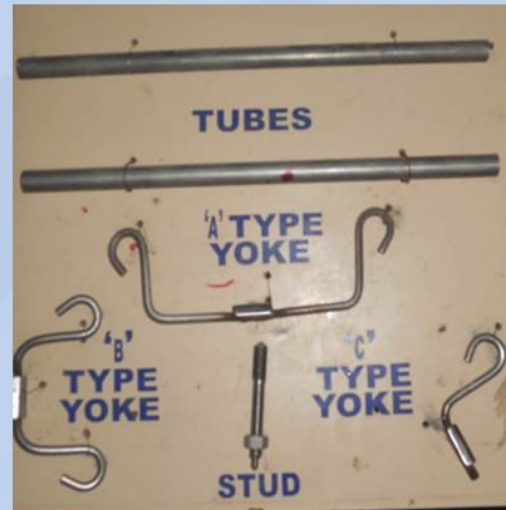
Sw 607 VF



Sw 607 Textiles



Next Generation Monolithic Module



www.morganadvancedmaterials.com

Pyrobloc - Product Features

- Monolithic structure
- Edge grain orientation
- Higher Installed Density Up to 240 Kg/cum. (160,192,240 Kg/Cum)
- Lowest K value
- True Multidirectional Compression
- Hardens On firing
- Can be easily cut to any shape at site
- Fast and Easy installation



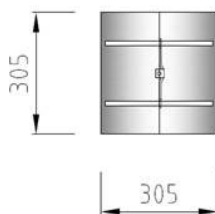
Advantageous of Pyro Bloc

SI NO	Pyrobloc Module	Folded Module
1	It is made from unique monolithic ceramic fiber (Pyrolog -150mm thk.) leads to less joints and suitable for high temperature application over folded modules	It is made by folding the blankets of 50mm thk. Due to more joints, performance is moderate.
2	The Pyrobloc monolithic edge grain surface and its property of hardening on firing gives resistance to high velocity gas erosion than folded modules.	Resistance to high velocity gas erosion is less than Pyrobloc modules.

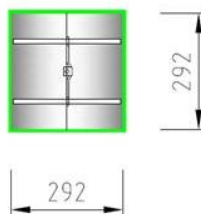


Advantageous of Pyro Bloc

SL NO	Pyrobloc Module	Folded Module
1	High compressed density (more than 240 Kg/m ³) leads to high insulation value (meager K value)	Max. Density achievable is 192 Kg/m ³ and it leads to moderate insulation value.
2	It can be compressed from all sides; hence shrinkage of fiber at high temperature can be arrested.	It can be compressed only on folded direction. And there is a possibility of shrinkage gap on other side at high temperature.



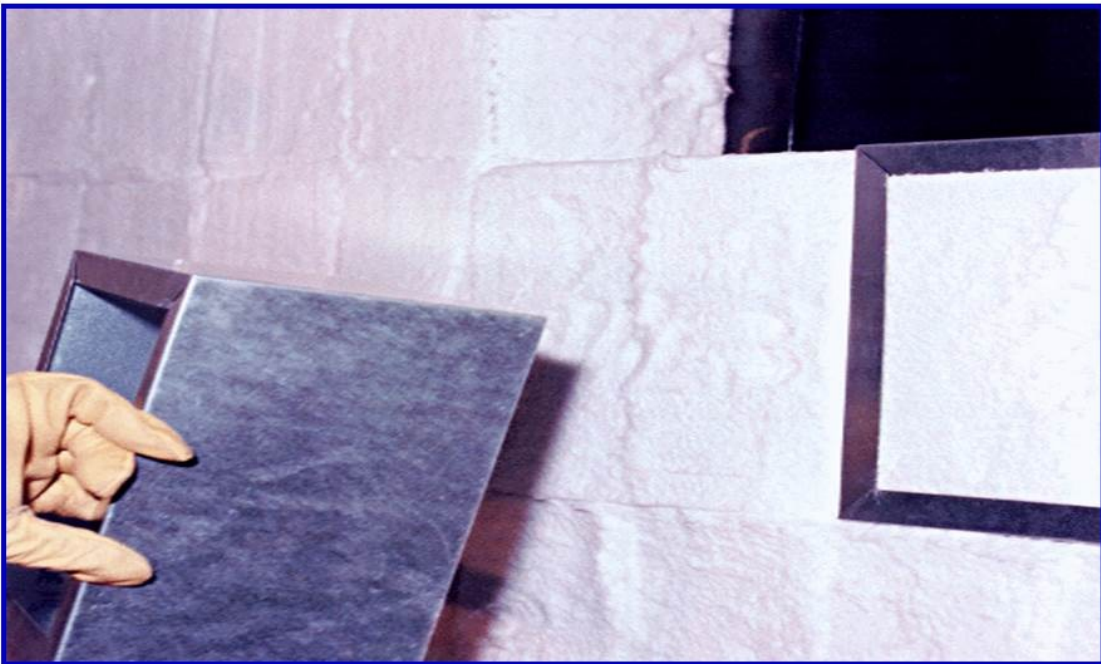
Supplied size
(305x305mm)



Installed size
(292x292mm)

Pyro-Bloc™ can be compressed in both the vertical and horizontal direction. During installation of Pyro-Bloc™ (Parquet pattern) the standard dimension of 305x305mm is compressed to 292x292mm (approx. 8% in area). These compressions are enough to compensate the fiber shrinkage of below 4% in long time operation period. care of the shrinkage effects.

Pyro Bloc Application



Bulk Density & Thermal Conductivity

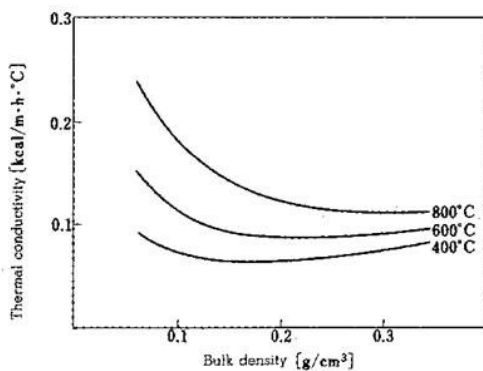
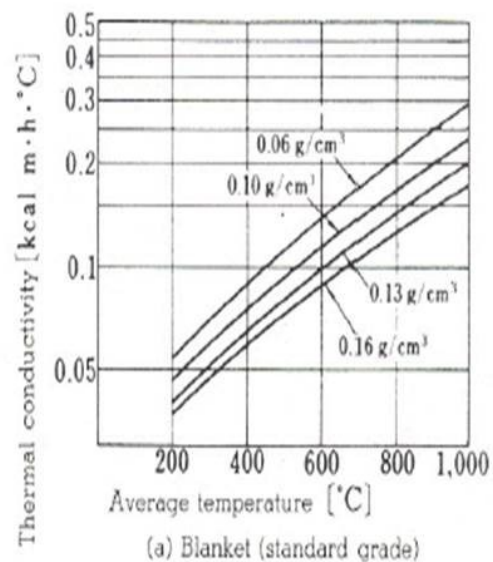


Fig.2.4. Relationship between bulk density and thermal conductivity of ceramic fiber blanket



(a) Blanket (standard grade)

Un like in other Refractories, In fibre K – Value decreases as the density increases up to a certain density and Most minimum at 200 – 250 Kg/cum



Radpro Paint

Contain heat energy with RADPro coating

The heating in sunlight is mainly due to radiation. Conduction and convection are secondary which transfer such generated heat. Conventional insulating products are designed to prevent conduction and convection. Radpro Insulmix is the only product which takes the care of radiation. The paint contains ceramic microspheres which are hollow and having vacuum inside.

These microspheres reduce the heat generation due to radiation considerably and also help reducing conduction and convection.

Being ceramic, they are inert and do not take part in any reaction with paint.

These microspheres are dispersed in water base acrylic latex paint to achieve the weather resistance, total waterproofing effect and getting the elastomeric effect.



Features of Radpro Paint

Radpro coating can be used for

- Thermal insulation (to contain heat energy inside the system)
- Anti rust, corrosion resistance
- UV resistance

Features

- Better heat containment
- 100% non toxic
- compatible with every material
- non- polluting



Features of Radpro

- Being elastomeric it takes the care of expansion and contraction of the surface on which it is applied.
- Since it is always visible on the top, any damage to it due to drilling, hammering or chipping can be repaired there only.
- It can be applied on Concrete, G. I. Sheets, as well as Asbestos sheets and to the exterior of the building.
- It can be applied externally to the buildings having central air conditioning to reduce the electricity consumption.
- Also since it can be manufactured in any shade, it is ideal for exterior surfaces as well as smoother version is available for interior use as finish coat.
- Hence RADPRO INSULMIX is one coating, which works as exterior/interior paint, waterproofing and most importantly thermal insulation coating and eliminates conventional waterproofing, and thermal insulation of the building.



Product Range & Application of Radpro

Sl. No	Product name	Temp range	Application areas
1	RADpro Insulmix EP	Upto 120°C	External surface of ovens, furnaces
2	RADpro H R T I 400	50 to 350°C	Hot Pipelines, non insulated surfaces of ovens etc.
3	RADpro H R T I 600	300 to 550°C	Hot Pipelines, non insulated surfaces of ovens etc. where the temperature is more than 250 Deg C.
4	RADpro H R T I 600 E P S I	300 to 550°C	Hot pipelines, non insulated areas but hot curing of the surface is not possible.
5	RADpro H R T I 1200 WB	550 to 1150°C	Internal surfaces of furnace where bricks or any other water absorbing hard surface is to be coated.
6	RADpro H R T I 1200 S B	550 to 1150°C	Metal hangers of refractory bricks, other metallic surface of furnace which comes in contact with heat of the mentioned range.
7	RADpro INSULMIX	Upto 120 °C	For metal, cement or concrete roofs and exterior walls to reduce heat load on the building.



Heat Flow Calculation as per existing practice

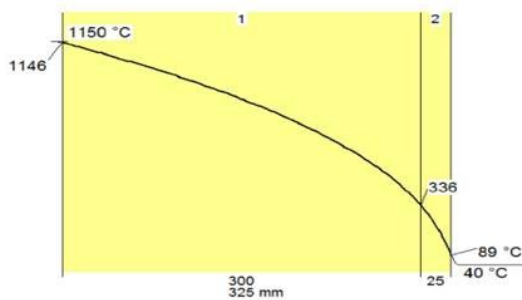
Calculation

Ambient temperature	inside	outside	unit	lining characteristics 639.3 W/m ² heat loss 42.15 MJ/m ² heat storage 50.4 kg/m ² weight 325 mm total thickness
Surface temperature	1150	40	°C	
Heat transition coefficient	1145.7	89.0	°C	
	150	13.05 ⁽¹⁾	W/m ² K	

(1) Calculated with ASTM C680, issue 2004 Emissivity=0.95 - wind =0.5 m/s

wall layers from inside to outside

Material	Thickn. mm	Density kg/m ³	Classif. °C	temperature °C		K mean W/mK
				border	mean	
1 Pyro-Stack-1430/160	300	160	1354	1145.7	830	0.2636
2 Cerablanket-96	25	96	1197	335.5	229	0.0673
				89		



Improved design Option- 1(With 192 Kg/ M3 Density Pyrobloc Module + Super wool blanket)

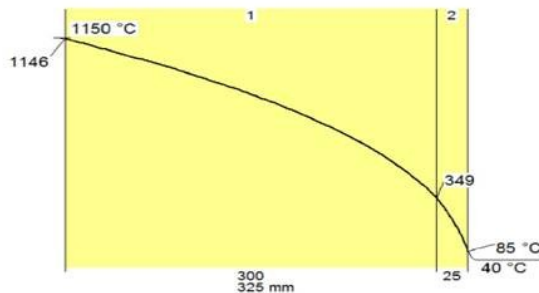
Calculation

Ambient temperature	inside	outside	unit	lining characteristics 577.8 W/m ² heat loss 50.82 MJ/m ² heat storage 60 kg/m ² weight 325 mm total thickness
Surface temperature	1150	40	°C	
Heat transition coefficient	1146.1	85.2	°C	
	150	12.79 ⁽¹⁾	W/m ² K	

(1) Calculated with ASTM C680, issue 2004 Emissivity=0.95 - wind =0.5 m/s

wall layers from inside to outside

Material	Thickn. mm	Density kg/m ³	Classif. °C	temperature °C		K mean W/mK
				border	mean	
1 Pyro-Bloc-Zr-192	300	192	1354	1146.1	835	0.2439
2 Superwool 607 Plus-96	25	96	1140	348.8	235	0.0571
				85.2		

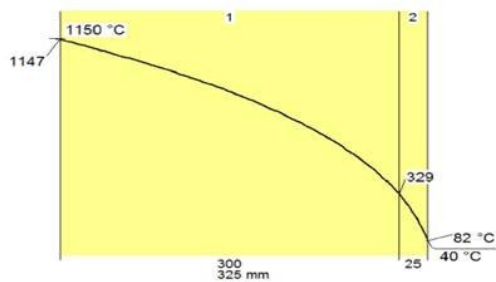


Improved design Option- 1(With 240 Kg/ M3 Density Pyrobloc Module + Super wool blanket)

Calculation

	inside	outside	unit	lining characteristics
Ambient temperature	1150	40	°C	520.7 W/m2 heat loss
Surface temperature	1146.5	81.5	°C	63.19 MJ/m2 heat storage
Heat transition coefficient	150	12.54 ⁽¹⁾	W/m2K	74.4 kg/m2 weight
<small>(1) Calculated with ASTM C680, issue 2004 Emissivity=0.95 - wind =0.5 m/s</small>				325 mm total thickness

wall layers from inside to outside		Thickn.	Density	Classif.	temperature		K mean
Material		mm	kg/m3	°C	border °C	mean °C	W/mK
1	Pyro-Bloc-Zr -240	300	240	1354	1146.5	832	0.213
2	Superwool 607 Plus-96	25	96	1140	328.7	222	0.0543
					81.5		



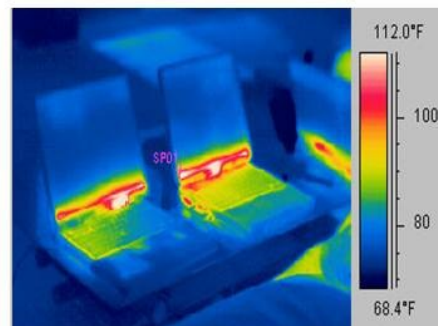
THERMOGRAPHY CAMERA



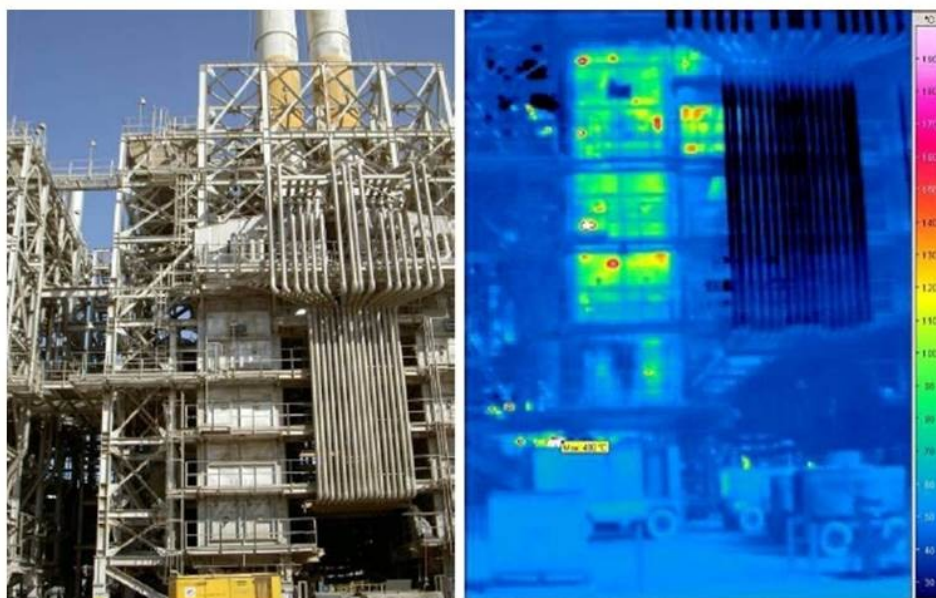
BENEFITS

- By using thermography we can identify the problems to the refractory in furnace or kiln.
- For continuous monitoring of lining condition.
- Based on thermography results result we will take preventive & corrective action to avoid breakdown..

PREVENTION IS BETTER THAN CURE



Furnace View: Hot Spots



What MMTCL offers

- Pre Inspection of Kilns
- Design & Engineering
- Turnkey solution including Application
- Thermography
- Wide range of product to chose for specific requirements



www.morganadvancedmaterials.com



SOLAR PULSE ENERGY PVT LTD

Solarizing your world

Corporate Office & HQ :-
F 104, Vardhman Grand Market, CSC,
Sector- 3, Dwarka, New Delhi- 110078
Contact: 011-4508 4785
Email: info@solarpulseenergy.com

Types of Solar Plants:

On- Grid

No battery backup
Economic
Net Metering
Preferred where grid avail.
Low maintenance

Off Grid

With Battery Backup
Expensive
No net metering
Preferred where no grid
High Maintenance



ROI

								8			
Electricity Tariff in Khurja in INR											
Space Required per kW								100		Sq Feet	
Annual Generation per kW								1350		kWh	
			Annual Return								
S. No.	Capacity (In kW)	Cost	Year 1	Year 2	Year 3	Year 4	AD	Total Return in 4 Years	ROI	Return (%) In 25 Yrs	
1	10	560000	108000	105300	104760	104220	147840	570120	4.0 Years	14.57	
2	20	1100000	216000	210600	209520	208440	290400	1134960	4.0 Years	14.9	
3	25	1300000	270000	263250	261900	260550	343200	1398900	3.5 Years	16	
4	30	1560000	324000	315900	314280	312660	411840	1678680	3.5 Years	16	
5	40	2040000	432000	421200	419040	416880	538560	2227680	3.2 Years	16.4	
6	50	2450000	540000	526500	523800	521100	646800	2758200	3.1 Years	17.22	
7	60	2880000	648000	631800	628560	625320	760320	3294000	3.1 Years	17.66	
8	70	3290000	756000	737100	733320	729540	868560	3824520	3.0 Years	18.12	
9	80	3760000	864000	842400	838080	833760	992640	4370880	3.0 Years	18.12	
10	90	4140000	972000	947700	942840	937980	1092960	4893480	3.0 Years	18.6	
11	100	4500000	1080000	1053000	1047600	1042200	1188000	5410800	3.0 Years	19.11	



Preview

- Benefits of Solar.
- Company Profile.
- Return on Investment.
- FAQs.



Benefits of Solar

Solar reduces air pollution.

- An average system size of 5 kW over 30 years will result in saving the amount of fuel it takes to drive you around the equator about 15 times or planting 1000 trees.

Solar saves water.

- A 5 KW plant in 30 years conserves so much water used in electricity production that it would fill 6 Olympic-sized swimming pools.

Solar is renewable & reduces the need for finite resources.

- The sun produces 173,000 terawatts of solar energy every second. That's more than 10,000 times the world's total combined energy use !

Financial Benefits of Solar

- Accelerated Depreciation can be availed by the solar generation agency with tax liability.
- It is a proven fact that the cost of establishing a solar power plant has reduced by almost 50% in past 5 years due to the continual advancements in solar panel technology which are increasing the efficiency and lowering the cost of production.
- The Break Even Point (BEP) of any solar power plant is around 3.5 years, after which a long & stable income is generated for a period of 25 years.



Company Profile

- Working in all the northern states of the country.
- MNRE Channel Partner & MSME Registered.
- Dynamic Management.
- All major Solar Products & Services.
- Experienced Team.
- Working with Defence Forces and Government.
- International Tie-ups.
- Accomplished Suppliers.



Company Profile : What we do



Company Profile : Projects Executed 2017-18

- 290 KW Grid Tied Solar Plant JK International, Jalandhar, Punjab.
- 135 KW off grid solar Plant at Ekanshi Engg. Pvt Ltd, Ranchi, Jharkhand
- 100 KW Solar Power Plant for Bhushan Steel Plant, Ghaziabad.
- 64 KW Grid Tied Solar Power Plant for factory of C.R. Foods India Pvt Ltd, located in Runkutta, Agra.
- 60 KW Grid Tied Solar Power Plant for factory of Kishore Exports, Agra.
- 50 KW Grid Tied Solar Power Plant for a residential property located in Chattarpur Farms, New Delhi.
- 50 KW Grid Tied Solar Power Plant for factory of M\ S Toplasts, Agra, UP.
- 40 KW Grid Tied Solar Power Plant for a residential property located in Chattarpur Farms, New Delhi.
- 33 KW Grid Tied Solar Power Plant for Action Construction Equipment Ltd (ACE).
- 23 KW Grid Tied Solar Power Plant for Ameyasha Hospital in Bulandshahar.
- 18 KW Grid Tied Solar Power Plant for HPCL Petrol Pump in Dwarka.
- 10 KW Grid Tied Solar Power Plant for Excel Rasayan Pvt. Ltd. located in Okhla Industrial Area.
- 10 KW Grid Tied Solar Power Plant for Metropolis India Pvt Ltd located in Okhla Industrial Area.
- 10 KW Grid Tied Solar Power Plant at Goel Nursing Home, Deoband.
- 10 KW Solar Power Plant for Army Aviation Base located in Jodhpur.
- 4000 LPD Solar Water Heater Project in Nutema Hospital, Meerut.
- 2000 LPD Solar Water Heater Project in Bharti College, Janakpuri, New Delhi.



Company Profile : Projects under execution

- 35 MW (20mw in Maharashtra+15 MW in UP)Grid Tied Solar Power Plant in Bhushan Steel Ltd. Current status – LOI Received. PPA being finalised.
- 290 KW Grid Tied Solar Power Plant for JK International. Current Status – Net metering under process.
- 135 KW Off Grid Solar Plant in Ranchi, Jharkhand. Current Status – Work order received procurement under progress.
- 1.2 MW (4x300 kw) Grid Tied Solar Power Plant in four factories in Yamuna Nagar. Current status – Loan being processed.
- 80 KW (2x 40 kw) Grid Tied Solar Power Plant for a residential property located in Chattarpur Farms, New Delhi. Current Status – Loan being processed.
- 60 KW Grid Tied Plant in Kishore Exports, Agra. Status – Work Order received procurement under progress.
- 40 KW Grid Tied Power Plant in Mohali, Punjab. Work order received. Procurement in progress.
- 300 Solar Street Lights in Uttarakhand. Current status - Work under progress.
- 25 KW Grid Tied Solar Plant in Metropol India Pvt Ltd Okhla Industrial Area. Current Status – Work order received. Procurement under process.
- 15 KW OG Solar Plant on Reliance Petrol Pump, Deoghar, Jharkhand.
- 10 KW OG Solar Plant on IOCL Petrol Pump in Deoghar, Jharkhand.
- Solar lighting of Agra Cantonment, Shatrujeet CSD Canteen Agra & Ghodakhali Sainik School.
- 4000 Solar Street Lights in villages of District Almora, Uttarakhand.



ROI

								8		
Electricity Tariff in Khurja in INR										
Space Required per kW								100	Sq Feet	
Annual Generation per kW								1350	kWh	
S. No.	Capacity (In kW)	Cost	Annual Return				AD	Total Return in 4 Years	ROI	Return (%) In 25 Yrs
			Year 1	Year 2	Year 3	Year 4				
1	10	560000	108000	105300	104760	104220	147840	570120	4.0 Years	14.57
2	20	1100000	216000	210600	209520	208440	290400	1134960	4.0 Years	14.9
3	25	1300000	270000	263250	261900	260550	343200	1398900	3.5 Years	16
4	30	1560000	324000	315900	314280	312660	411840	1678680	3.5 Years	16
5	40	2040000	432000	421200	419040	416880	538560	2227680	3.2 Years	16.4
6	50	2450000	540000	526500	523800	521100	646800	2758200	3.1 Years	17.22
7	60	2880000	648000	631800	628560	625320	760320	3294000	3.1 Years	17.66
8	70	3290000	756000	737100	733320	729540	868560	3824520	3.0 Years	18.12
9	80	3760000	864000	842400	838080	833760	992640	4370880	3.0 Years	18.12
10	90	4140000	972000	947700	942840	937980	1092960	4893480	3.0 Years	18.6
11	100	4500000	1080000	1053000	1047600	1042200	1188000	5410800	3.0 Years	19.11



Frequently Asked Questions

- What is Net Metering?
- What is the cost of a solar plant?
- What is the maintenance of a solar plant?
- Will the solar plant work in all weather?
- What are the warranties of a solar power plant?
- How much will the solar plant produce everyday?
- What is the life of a solar plant?
- Can it be installed on any asbestos roof?



Solar Pulse Energy

Solarizing your world



Thanks !