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UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

NATIONAL PROGRAMME TO SUPPORT ENERGY EFFICIENCY AND QUALITY STANDARDS IN CERAMIC SSI UNITS IN INDIA

(PROJECT NUMBER USIND05001 & TFIND07001)

END OF PROJECT REPORT

PROJECT EXECUTED BY

United Nations Industrial Development Organisation

PROJECT FUNDED BY

Department of Industrial Policy and Promotion (DIPP),
Ministry of Commerce & Industry, Govt. of India—IDF Contribution
National Council for Cement and Building Materials (NCB)—Trust Fund Contribution

PROJECT DURATION

June 2005–December 2010



DISCLAIMER

The report is a cumulative presentation of all the activities undertaken during the project period, and attempts to provide a subjective conclusion based on the information drawn from the various activity and study reports done during this period. It is not an attempt to analyse and present the outcome of the project through detailed quantitative study.[*]

Impact of Liquefied Natural Gas

There was a change in fuel from coal and diesel to Liquefied Natural Gas (LNG) in Morbi and Thangadh cluster in Gujarat. This change occurred during the mid-phase of the project and had an impact on the outcome of the energy efficiency measures initiated by United Nations Industrial Development Organization (UNIDO).

The impacts can be better understood and analysed through a detailed quantitative study, which is beyond the scope of this document.

[*] Detailed evaluation report to be prepared by UNIDO

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Project Team

EXECUTIVE SUMMARY

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

Project number	**USIND05001 & TFIND07001**
Project title	**National Programme to Support Energy Efficiency and Quality Standards in Ceramic SSI Units in India**
Country	**India**
Clusters	**Khurja (Uttar Pradesh), Morbi (Gujarat), and Thangadh (Gujarat)**
Date of starting	**June 2005**
Project duration	**Three years, extended up to June 2010**
Total budget	**$600 000**
Implementing agency	**UNIDO**
Counterpart agency	**DIPP, Government of India, and NCB**

Summary

The Indian ceramic industry, being the basic building block for the construction and household sectors, contributes considerably to India's economic progress. With growing urbanization and increasing use of ceramic tiles and sanitary ware in the Indian construction sector, the industry is expected to grow further at an increased rate. Though there are many large companies in the Indian ceramic industry, the small and medium enterprises (SME) sector is a major player, accounting for more than 50% of the market share. The SME ceramic industry has developed in clusters in Khurja in Uttar Pradesh, for crockery and allied items and in Morbi and Thangadh in Gujarat, for tiles and sanitary ware. These SME clusters face stiff competition from international markets on issues related to quality and price.

The small-scale ceramic tile and sanitary ware units in India are characterized by obsolete technologies and energy-inefficient operations. These units usually do not have the capacity to upgrade their production processes and adopt new and energy-efficient technological options. There is also a lack of exposure to new technology and an enabling environment (in terms of human and institutional development) that can promote technological upgradation in these industries.

The ceramic industry is highly energy intensive and the fuel and energy costs account for 25%–30% of the total production costs. According to recent estimates, 20%–25% of energy savings is possible in the ceramic sector through adoption of energy-efficient technologies and processes, energy audits, capacity- building, use of cleaner fuels, and information dissemination.

Keeping in mind the significance of energy-efficient technologies and the critical role they can play in making ceramic materials more energy efficient, a National Programme to Support Energy Efficiency and Quality Standards in Ceramic SSI Units in India was initiated by UNIDO in June 2005, in collaboration with DIPP, Government of India, and NCB.

The main objective of the programme was technology upgradation of selected ceramic units at the three clusters—Khurja, Morbi, and Thangadh—by adopting energy-efficient technologies and processes, and improving their competitiveness by enhancing productivity, achieving economies of scale, introducing new designs, encouraging quality controls, and adopting international standards. In addition, the programme aimed at capacity-building of enterprises, workers, and managers and strengthening of institutional structures together with promotion of Indian brand image and improving the quality of ceramic products.

The main objectives of the project, the targeted outputs, and deliverables were all achieved in an accomplished manner. Under the project, overall savings in the range of about 25% were achieved as a result of the project interventions, large-scale adoption and replication of energy-efficient technologies and other measures including diagnostic studies, energy audits, quality standards, training and capacity-building, exposure visits to ceramic units of developed and competing nations, and switch over to cleaner fuels.

Initially, diagnostic studies of the ceramic units in the three clusters (50 units in Khurja, 35 units in Morbi, and 25 units in Thangadh) were conducted by Shri Shakti Alternative Energy Limited (SSAEL) of Hyderabad, Andhra Pradesh. The objective of the studies was to assess their present status of technology, energy use, and processes. Special emphasis was given on competitiveness and resource conservation to identify problems/bottlenecks/constraints/issues, suggest solutions to problems, and make recommendations on activities/interventions for implementing the project.

On completion of the diagnostic studies, its aim, activities, and expected results were explained to the ceramic units and industry associations of Khurja, Morbi, and Thangadh through presentations during field visits and interaction meetings with stakeholders during July–August 2005. An ‘Interaction Meeting of Stakeholders’ was organized in December 2005 at CGCRI, Khurja, and a lecture/talk on 'Energy-Efficiency Measures in Tunnel Kilns - Possibilities' was also delivered by the PCRA during the meeting, to create awareness on the aims and objectives of the project among the stakeholders. The awareness campaign succeeded in convincing the units about the merit of the programme and motivated them to participate. (See Annexure1)

Following the diagnostic studies, 15 representatives of (in terms of product, technology status, and size of units) ceramic units were selected from the three clusters (eight in

Khurja, four in Morbi, and three in Thangadh) for carrying out energy audits (in June–July 2006) and demonstrating energy-efficient technologies and processes, raw material and quality standards, and benchmarked against the best in technology, quality, cost effectiveness, and marketing linkages.

Workshops were organized at each of the three clusters, in association with the local industry associations, to demonstrate and disseminate the effectiveness of the recommended energy-efficiency measures to the unit management and supervisors in about 100 ceramic SME units at Khurja on 16 April 2007 and at Morbi and Thangadh from 2–5 May 2007.

Training programmes were conducted for three days at each of the three clusters—Khurja, Morbi, and Thangadh—during July–August 2009 for kiln-operating personnel and maintenance personnel. The programme included classroom and field observations and demonstrations, provided hands-on training on energy-efficient technologies, maintaining quality standards of raw material, quality testing, and productivity, and market research and strategies. The training capsule was developed keeping in mind the educational background of the targeted audience. As many as 41 supervisors and kiln operators in Morbi, 28 in Thangadh, and 21 in Khurja attended the training programme. The training was conducted by trainers from Shri Shakti Alternative Energy Limited of Hyderabad.

For the first time, units at all the three clusters were exposed to the concept of lean manufacturing to enhance their cost competitiveness. UNIDO, in consultation with Morbi Dhuva Glaze Tiles Association, Morbi, and Sanitary wares Manufacturers Association, Morbi, introduced the concept of lean manufacturing to the ceramic units from Morbi during a day-long seminar on 6 April 2007. In Thangadh, the concept was introduced in consultation with the Panchal Ceramic Association (Vikas Trust), Thangadh, and the Federation of Ceramic Industries, Thangadh, through an 'Awareness Programme on Lean Manufacturing Techniques' on 7 April 2007. In Khurja, the workshop was held on 14 April 2007. M/S Q-spread, New Delhi, a renowned consultancy firm in the field of lean manufacturing practices, was employed to introduce the concept in all the three clusters. Thirty-five entrepreneurs attended the workshop at Morbi, while 30 each were present at the Thangadh and Khurja workshops.

In order to build its capacity, CGCRI Khurja was supported in its efforts at developing rapid-fire technology for tablewares. Another important activity outlined under the project was the development of a common testing facility at Khurja. However, CGCRI, Khurja, already had such a facility for use by small scale industries (SSI) units. Hence, sophisticated testing equipments—Dilatometer, Thermal conductivity equipment and PCE furnace—were provided to the NCB, at Ballabgarh, for advanced testing of ceramic raw material, measuring energy efficiency, and so on.

Effective international linkages were provided through visits to ceramic units of competing nations, visit of international experts to selective units, and participation in international exhibitions and fairs. Exposure-visit-cum-study-tours were organized for a 22-member delegation (18 ceramic manufacturers and four local industry association representatives) from the three clusters to the 21st International Ceramic Industry

Exhibition at Guangzhou, China, and to the ceramic industry at Foshan and Chouzhou from 31 May 2007 to 5 June 2007. (See Annexure2)

International exposure was provided to two officers from the NCB through their participation in the 10th Unified International Technical Conference on Refractories (UNITECR 2007) at Dresden, Germany from 18–21 September 2007. During their visit, the delegation had the opportunity to attend various sessions on technical development in the field of refractories, current benchmark of consumption of refractory in cement and steel industries in different countries, recycling of used refractory materials to address the problem of disposal, and so on. The NCB officers also visited a concurrently-organized exhibition that showcased new equipments and technologies and raw material. The major emphasis of newer technologies and application of raw material was on enhancing the longevity of refractories in different industries.

During the exposure-visit-cum-study-tour to China in May 2007, the entrepreneurs of the units expressed interest in organizing inspection of the Indian ceramic units by international kiln experts/manufacturers to enable them to understand the shortcomings and take remedial measures for improving the kilns. Accordingly, in March 2008, experts from M/s Beaumont Kilns Ltd, UK, and M/s Kexinda, China, were invited to visit factories of 17 selective ceramic units at Morbi, Thangadh, and Khurja. M/s Beaumont Kilns Ltd is the pioneer in the field of continuous and intermittent kilns. M/s Kexinda and M/s Beaumont have established a joint venture. The visit intended to identify major technology-gap between the kilns in Indian ceramic SSI units and their counterparts in developed countries. An important outcome of the visit was that the entrepreneurs of the selective ceramic units were motivated to improve their kilns on the basis of expert inputs. The delegation of experts visited the factories of the units from 27–31 March 2008. (See Annexure3)

Further, a visit was organized for five manufacturers from Morbi to the Coverings Fair at Orlando, Florida, USA from 29 April to 2 May 2008 with the aim of providing selective ceramic units from the clusters, international exposure, and access to new markets. The participating units displayed their products in the international exhibition for the first time, thus getting the opportunity to explore an important market, and compare the cost and quality of their products with that of the competing nations. (See Annexure4)

A dedicated bi-lingual (Hindi and English) website, with its own URL/ domain name, was developed to act as clearing house mechanism for information dissemination. The website, hosted on the server of DIPP, Ministry of Commerce, Government of India, during the currency of the project, proved to be a repository of information for manufacturers, exporters, and buyers of ceramic products in India. The technical section of the website contained information about technical matters mostly relevant to the small- and medium-scale manufacturers of ceramic products.

Two films were prepared under the project. The interim film/documentary on ‘Ceramic SMEs in India: Opportunities Ahead’ portrays the problems faced by the small-scale ceramic industry in India – obsolete and inefficient or second-hand imported technology, non-standard, and inconsistent raw materials, high transportation costs, stiff competition by international players, and so on. Interviews with DIPP, UNIDO, and CGCRI officials,

along with the actual manufacturers, talk about the joint programme between UNIDO and the Indian government to employ energy-efficient technologies in select ceramic units in Uttar Pradesh and Gujarat, and also to improve the quality of their products and provide them with the right financing and marketing linkages. The film talks about the efforts that are also on to replace diesel and coal with cleaner fuels such as producer gas, liquefied natural gas, and even biomass. Film II is a documentary portrayal of UNIDO's interventions made during the period (September 2004 to 30 June 2010) in the three selected ceramic clusters of India, to improve the overall market competitiveness of the cluster units and mitigate greenhouse gas (GHG) emissions by enhancing energy efficiency and overall productivity through standardization of raw materials, finished products, and so on.

To help the Indian ceramic industry maintain quality of its products and enhance cost competitiveness, a Manual on 'Quality Standards, Testing Procedures and Environmental, Health and Safety (EHS) Practices for Ceramic Industry in India' has been prepared as part of the project. The manual is written in vernacular languages, Hindi and Gujarati, for the benefit of supervisors, entrepreneurs, ceramists, and others connected with the ceramic industry. The manual, developed in association with CGCRI, Ahmedabad, Gujarat, is the first-of-its-kind in India. It is designed as a reference book that introduces the basic quality measures pertaining to ceramic manufacturing to the existing ceramic units in India. The summary version of the manual (in English) was released during the project closing workshops held in the three clusters in the month of June 2010. The complete manual—Hindi and Gujarati version—is under process as on date.

A study titled 'Scoping Responsible Behaviour in SMEs in India' was undertaken with the aim of looking at the CSR elements in these three ceramic clusters, which added to one of the cross cutting themes under the larger project—gender strategy to address specific needs of men and women employees working in the ceramic SSI sector by following cluster approach and networking with all key stakeholders to expedite the adoption and replication of new and efficient technologies and measures.

The most important achievement of the project has been the contribution of the units and project counterparts. The units' contribution was in the form of partial financing of activities such as energy audits, study trips, participation in national/international fairs, training programmes, and in technology equipments. One-fourth of the cost of diagnostic studies and energy audits were borne by the participating entrepreneurs. Half of the cost of activities like exposure tours/study trips and participation in international fairs was borne by the associations and entrepreneurs themselves.

The project has made a great impact on the ceramic units in the Khurja, Morbi, and Thangadh cluster. It has brought about substantial savings in the energy consumed, while improving the overall quality standards of SSI units in the three clusters. The project initiatives have resulted in enhancing the competitiveness of the units and simultaneously improving the local environment. The successful implementation of the project has carved a road map for initiating more such projects in energy-intensive SSI clusters.

CHAPTER 1 BACKGROUND AND CONTEXT

Various types of ceramic articles, such as crockery, sanitary ware, artware, tiles, refractory, stoneware, pipes, and many others, play an important role in our lives. Ceramics have also forayed into industries for use as insulators, laboratory wares, electrical and electronic items, and so on.

The Indian ceramic industry, being the basic building block for the construction and household sectors, contribute considerably to India's economic progress. Ceramic tiles and sanitary wares are important inputs for the modern construction industry in India. Typical application of ceramic in the construction sector ranges from flooring tiles, to decorative tiles, and wall tiles, among others. Similarly, use of sanitary ware is indispensable in the modern construction industry. Average annual growth rate of the tile and sanitary ware industry has been about 12%. With growing urbanization and increasing use of ceramic tiles and sanitary ware in the Indian construction sector, it is expected that the industry will succeed in meeting the demands of this sector. Since the ceramic industry is highly energy-intensive, the fuel and energy costs account for 25%-30% of the total production costs.

Keeping in mind the significance of energy-efficient technologies and policies, and the critical role they can play in making ceramic materials more energy efficient, a National Programme to Support Energy Efficiency and Quality Standards in Ceramic SSI Units in India was initiated by UNIDO in June 2005, in collaboration with DIPP and NCB.

Though there are many large companies in the Indian ceramic industry, the SME sector is a major player, accounting for more than 50% of the market share. The SME ceramic industry has developed in clusters in Khurja in Uttar Pradesh, for crockery and allied items; and in Morbi and Thangadh in Gujarat, for tiles and sanitary ware. In Morbi and other parts of Gujarat, 900 units engaged in the organized and unorganized sectors provide employment to a large number of people in both urban and rural areas. About 500 ceramic and pottery units are concentrated in Khurja. These SME clusters face stiff competition from international markets on issues related to quality and price.

Since large-scale units are few in number and are technologically much advanced than their counterparts in the small-scale sector, the project focused on improving the energy efficiency of small-scale units. Normally, these units do not have sufficient technological, financial, and institutional capacity and exposure to upgrade and modernize their technology and production processes. The programme is an initiative in India to reduce energy costs, improve productivity, foster market linkages, and promote the Indian brand image.

Jointly with DIPP and NCB, UNIDO selected small- and medium-scale ceramic units and clusters at Khurja, Morbi, and Thangadh keeping in mind the product, technology, and size of units for demonstrating effectiveness of energy-efficient technologies and quality measures to enhance their competitiveness and quality of products, while reducing the costs of energy consumption.

CHAPTER 2 PROJECT OBJECTIVES AND RATIONALE

2.1 Project objectives

The main objectives of the programme were technology upgradation of selected ceramic units at Khurja, Morbi, and Thangadh by adopting energy-efficient technologies and processes; and improving their competitiveness by enhancing productivity, achieving economies of scale, introducing new designs, encouraging quality controls, and adopting international standards. In addition, the programme aimed at capacity-building of enterprises, workers, and managers, and strengthening of institutional structures together with the promotion of the Indian brand image and improving the quality of ceramic products.

2.2 Rationale of project

The small-scale ceramic tile and sanitary ware units in India are characterized by obsolete technologies and energy-inefficient operations. These units usually do not have the capacity to upgrade their production processes and adopt new and energy-efficient technological options. There is also a lack of exposure to new technology and an enabling environment (in terms of human and institutional development) that can promote technology upgradation in these industries.

According to recent estimates, 20%–25% of energy savings is possible in the ceramic sector through adoption of energy-efficient technologies and processes, energy audits, capacity-building, use of cleaner fuels, and information dissemination.[1]

The Government of India is also giving greater emphasis on deployment of energy-efficient measures in the industrial sector with active participation from the industry, through various policies and institutional measures. The small-scale ceramic industry sector is at the crossroads of options regarding energy-efficient technologies and needs some amount of hand-holding in order to make the best use of the government's initiatives. Introduction of energy-efficient technologies and other measures like technology upgradation, raw material quality, enhancing quality standards, and testing facilities, as envisaged in the UNIDO programme, has provided the necessary support to ceramic SSI units, and has brought about substantial savings in the energy consumed, while improving the overall quality standards of SSI units in the three clusters of Khurja, Morbi, and Thangadh. These measures resulted in enhancing the competitiveness of the units and, simultaneously, improving the local environment.

[1] Project Document on "National Programme to Support Energy Efficiency and Quality Standards in Ceramic Industries", signed October 2004, page no. 1

2.3 Target beneficiaries

Although ceramic units are scattered all over the country, in Morbi and other parts of Gujarat, 900 units, engaged in organized and unorganized sectors, provide employment to a large number of people in both urban and rural areas. About 500 ceramic and pottery units are concentrated in Khurja (Uttar Pradesh). The project aimed at supporting the energy-intensive and export-oriented ceramic SSI units based in the two clusters of Khurja and Morbi by introducing energy-efficient technologies, technology upgradation, and improving productivity, and marketing support. However, during the course of project implementation, as advised by the National Project Steering Committee, the ceramic cluster at Thangadh in Gujarat was also included in the project. Thus, the project activities and interventions covered three ceramic clusters in the states of Uttar Pradesh and Gujarat. The project also envisaged capacity-building of key national institutions such as CGCRI and NCB, and industry associations with regard to energy efficiency, quality control, and standards.

2.4 Expected outcome

Improvements in energy efficiency in ceramic and sanitary ware units were envisaged to meet the twin objectives of improving competitiveness of the small-scale units and mitigating GHG emissions in the long run. A holistic approach was to be adopted to improve energy efficiency and overall productivity in the small-scale ceramic tile and sanitary ware units at Khurja, Morbi, and Thangadh. On completion of the project, it was expected that its main objectives would be met by addressing the key barriers in order to promote energy efficiency, quality of raw materials, and testing facilities in the concerned ceramic SME units.

The following are some of the specific deliverables outlined in the project.

- Overall cost saving of 20%–25% in energy consumption through large-scale adoption and replication of energy-efficient technologies and other measures including diagnostic studies, energy audits, quality standards, training, and capacity-building.

- Ten representative ceramic units selected for demonstrating energy-efficient technologies and processes, raw material, and quality standards and benchmarked against the best in the category in terms of technology, quality, cost effectiveness, and marketing linkages; and the lessons learned disseminated among 100 SME units.

- Fifty entrepreneurs, managers, experts and planners trained under the project in energy-efficient technologies, quality standards of raw material, quality testing and productivity, and market research and strategies.

- Visits to two international trade fairs on construction sector and ceramic products undertaken, along with two study trips within and outside the country.

- A common testing facility created at Khurja, and a dedicated website developed to facilitate information dissemination.

- Cross-cutting themes such as gender strategy examined to address specific needs of men and women employees working in the ceramic SSI sector.

- Institutional capacity built through training and servicing at NCB, NPC, CGCRI, and state-level institutions through training workshops and seminars organized under the project.

- Periodic review of achievements undertaken at the project level and on a half-yearly basis at the steering committee level to ensure effective monitoring and evaluation of the project activities.

CHAPTER 3 BUDGET AND FINANCES

3.1 Planned budget

The planned budget for the project is as follows.

Table 3.1 Initial planned project budget[2]

Title	W/M	IDF US$	NCB US$	Khurja Indus. Scheme	Planned US$
International Experts	4	15,000	20,000	10,000	45,000
Project Staff Travel		10,000	10,000	10,000	30,000
UNIDO Staff travel		15,000	10,000		25,000
National Experts		20,000	20,000	20,000	60,000
Sub-Contracts		50,000	25,000	25,000	100,000
Study Tours		10,000	10,000	10,000	60,000
Training		25,000	45,000	30,000	100,000
Equipment		25,000	35,000	40,000	100,000
Miscellaneous		6,991	7,000	7,000	20,991
Total		**176,991**	**182,000**	**182,000**	**540,991**
UNIDO Support Costs		**23,009(13%)**	**18,000 (10%)**	**18,000 (10%)**	**59,009**
Project Total		**200,000**	**200,000**	**200,000**	**600,000**

* Transfer of funds within the budget lines is permissible during the implementation phase of the project, based on amendments in the activities discussed with the counterparts.

** Budget is divided into IDF, NCB, and Khurja Industrial Infrastructure Upgradation Scheme Contributions.

*** Ceramic Small Scale Association/Units at Morbi and Khurja to provide $250,000 in cash/kind to the project for the activities such as study trips, training programmes, and technology equipments. Activity wise funds will be firmed up during the consultations with the ceramic units as a start up activity and approved by the steering committee.

[2] Source: End of project report and expense details as shared by UNIDO personnel

3.2 Actual expenditure

Table 3.2 Final Project Financial Statement

Agency	Committed US$	Released US$	Utilized US$
DIPP	358,991	353,982	351,953
NCB	182,000	185,556	185,536
UNIDO Support Cost	59,009	60,462	60,462
Un-Obligated Amount	-NA-	-NA-	2,049
Total	**600,000**	**600,000**	**600,000**

Table 3.3 Table 4 Fund Utilization (Excl. UNIDO support cost): Final Financial Allotment and Actual Disbursement

Expenditure Head	Planned Allotments US$	Actual Disbursements US$
Audit/Experts/Training	129933	129808
Equipment	126448	126447
Project Staff	131648	131648
Sundries	72891	73078
Travel & Study Tours	78618	76508
Project Total	**539538**	**537489**

In-kind contributions by industry

The contribution of the units to the project were in the form of partial financing of all main activities such as energy audits, study trips, participation in international fairs and training programmes, and in technology equipments. One-fourth of the cost of diagnostic studies and energy audits were borne by the participating entrepreneurs. Half of the cost of activities like exposure tours/study trips and participation in international fairs, and logistics of international experts were borne by the entrepreneurs of selective units themselves. The units themselves took care of the costs on a per-day basis, payable to those who participated in international events and workshops on awareness programmes.

Further, the government of Gujarat also agreed to provide financial support for activities with regard to adoption of energy-efficient technology, energy-conservation initiatives, environmental-protection measures, and common facilities with respect to Gujarat-based units under the state government schemes.

Table 3.4 In-kind contributions by industry

No.	Activity	Contribution of unit owners[3]
1	Diagnostic studies and energy audits	25% of the cost of consultancy amount
2	Workshops (two in each of the three clusters)	All costs related to logistics and local transport during the workshops
3	Training of supervisors (one training per cluster of three days duration)	All logistics and opportunity costs (for owners and supervisors)
4	International exposure visits: 1. 21st China International Ceramics Industry Exhibition at Guangzhou 2. Ceramic city centres and ceramic manufacturing units at Foshan and Chouzhou	All costs related to boarding, lodging, and local travel
5	Exhibition: Coverings Fair at Orlando (USA)	75% of the total costs (including logistics, cost of building exhibition booths, international travel, boarding and lodging)
6	Workshops on lean manufacturing at the three clusters	Cost of local boarding and lodging, local travel of faculty, cost of tea and lunch during the workshops, and cost of the venue at each location (borne by local associations)

[3] Information based on discussions with Mr Upendra Malik (Former Project Coordinator)

CHAPTER 4 PROJECT IMPLEMENTATION, ACTIVITIES UNDERTAKEN AND ACCOMPLISHMENTS AGAINST PLAN

4.1 Project implementation summary

The project document for the **National Programme to Support Energy Efficiency and Quality Standards in Ceramic SSI Units in India** for a planned duration of three years was signed between UNIDO and DIPP in October 2004. However, the project became operational only in June 2005, with the posting of the project coordinator. Thereafter, the project completion period was extended till June 2010.

Initially, under the programme, ceramic clusters of Khurja (Uttar Pradesh) and Morbi (Gujarat) were identified for interventions after due interaction with project counterpart institutions (NCB and CGCRI) and stakeholders, and based upon UNIDO's experience of a similar project in partnership with MSME in the hand tools sector. Khurja was identified because of the existence of low-end technology, while Morbi was the comparatively advanced technology cluster. However, upon the recommendations of the National Steering Committee, a third ceramic cluster at Thangadh (Gujarat) was also included in the project. Though the project area was expanded, thereby increasing the number of target beneficiaries, it did not entail any increase in the total project outlay, as outlined in the project document.

4.2 Project partners

The programme was initiated as a joint venture of the DIPP, Ministry of Commerce and Industries (MoCI) of the Government of India, the NCB, and UNIDO.

The project was coordinated and implemented by UNIDO under the overall guidance and supervision of a National Steering Committee, notified by DIPP. The steering committee was chaired by the Joint Secretary, DIPP, with representation from DIPP (Government of India); UNIDO; Ministry of SSI; Bureau of Energy Efficiency (Ministry of Power); state governments of Uttar Pradesh and Gujarat—through their director of industries and SSI associations; Small Industry Development Bank of India (SIDBI); Indian Ceramic SSI Association, and local associations at Morbi and Khurja; national institutions like the NPC, NCB, and CGCRI, and Federation of Indian Chamber of Commerce and Industry (FICCI).

Other cooperating agencies and partners included state government institutions, apex and local industrial associations, ceramic SME units, financial institutions, NGOs, and research and development institutions.

4.3 Project strategy

A two-pronged strategic approach was adopted to achieve the project objectives, which included the following.

a) Demonstration of appropriate and energy-efficient technologies, quality of raw material, and glazing and firing processes
b) Capacity-building of key institutions and assisting in the creation of a conducive environment including appropriate policies for large-scale adoption and replication of energy-efficient technologies, quality standards, and testing facilities

4.3.1 Project design and activities

The design methodology for the planned activities consisted of selection of units in each cluster fulfilling the laid-down criterion; diagnostic study by experts to identify the constraints and potential; energy audits of 15 selected units, creating baseline energy consumption levels and benchmarking; and finally, preparation of a need-based action plan to meet the varied project objectives of energy-efficiency improvement, technology upgradation, improvement of quality and productivity, and strengthening of the national institutes and policy framework. The implementation strategy focused on capacity-building through training programmes, workshops, and participation in trade fairs and study tours. (See Annexure 5)

Diagnostic studies of all three ceramics clusters, that is, Khurja, Morbi, and Thangadh were conducted by SSAEL of Hyderabad, Andhra Pradesh. The objective of the studies was to assess their present status of technology, energy use, and processes. Special emphasis was given on competitiveness and resource conservation, to identify problems/bottlenecks/constraints/issues, and suggest solutions to problems and make recommendations on activities/ interventions for implementing the project. (See Annexure6) The outcome of cluster-wise diagnostic studies, in brief, is provided below.

Khurja cluster: structure and technology status[4]

Khurja, located at 28° 15' latitude and 77° 50' longitude in the state of Uttar Pradesh, is well known for its pottery industries. It is situated approximately 20 km from Bulandshahar, beside the Grand Trunk (GT) Road. Khurja is bordered by Badaun in the east, Secunderabad in the west, Bulandshahar in the north, and Aligarh in the south. It lies about 4 km away from the Delhi-Howrah main railway line. The distance from Delhi is about 93 km.

Khurja's climate is tropical. During summers, the maximum temperature reaches as high as 48 °C, while in winters the mercury drops to as low as 3 °C. The average rainfall is 580–690 mm. Khurja is an important *tehsil* of Bulandshahar district. Urban development initiatives at Khurja are carried out by the Bulandshahar Development Authority (BDA). The city is spread over 10.36 km^2 and falls under the Khurja Municipal Corporation. With about 500 units in the small-scale sector, Khurja has become a centre of the ceramic industry. In local language, *'Khurja'* means 'wasteland'.

a) As per the Khurja Pottery Manufacturers Association (KPMA) and CGCRI there are about 491 (independent) pottery units operating in the cluster. In addition to these independent units, there are about 150 dependent[5] units, of which, only about 60 are currently operational. While details on the dependent units are not available, responses during the diagnostic survey suggested that most of these units are not doing too well because they do not have any facilities for captive raw material processing or firing. They procure body and glaze in readymade form and manufacture greenware in their units, while renting kiln space from other units.

[4] Diagnostic Study Report for Khurja Pottery and Ceramics Cluster, February 2007. (Prepared by Shri Shakti Alternative Energy Ltd Hyderabad, India)

[5] Dependent Units: Units that manufacture their products within their factory premises but do not have their own kilns to fire their products; hence, being dependent on other units with firing facilities in their premises.

Majority of the 491 units are traditional. Almost all of these units are at least 10 years or more old. They commenced operations with low capital investments, and utilize simple and old technologies. Currently, more than 250 of these units have invested in HSD or C-9 fired shuttle and tunnel kilns, thereby moving away from the older coal-fired downdraft kilns.

The total production (in tonnes)—ranging from 15 tonnes per month–70 tonnes per month for a unit—depends on the product and demand during various seasons. Demand for industrial products like insulators and transformer bushing is more or less steady across the year. However, production of crockery and tableware production is cyclical in nature, being maximum during summers and minimum during the rainy season.

Khurja's ceramic and pottery products are sold all over India, and are exported as well. The cluster has more than 50 export-oriented pottery units. Foreign clients include Australia, Nepal, New Zealand, the UK, the USA, and the United Arab Emirates. The major export items are ceramic art ware, insulators, and scientific porcelain.

b) The various products manufactured by the cluster include HT and LT insulators, bone china and stoneware crockery, HV and LV transformer bushings, disc pins and post insulators, tableware, *khullars* (earthen tea cups), laboratory items, handmade ceramic tiles, fancy items and art wares, and so on. Mainly, white ware is produced in this cluster. However, a small amount of high-fired terracotta is also produced for export markets. Most of the pottery units manufacture crockery (stoneware), HT/LT insulators, and decorative wares (stoneware). Only a few specialized units manufacture sanitary wares, bone china, and chemical porcelain.

   The raw materials used in the cluster include clay, stone, quartz (from various parts of Rajasthan and Gujarat) and bones (from Meerut and Muzaffarnagar in Uttar Pradesh). These raw materials have various impurities that result in a number of defects in the preparation of greens, and also adversely affect the quality of the final products. Therefore, the raw materials need to be tested regularly for their properties and composition. Although such testing facilities are available at CGCRI, Khurja, many units do not test the procured raw materials on a regular basis. In addition to quality, processing of raw materials also has significant impact on the quality of final products.

c) The types of kilns operational in the cluster include coal-fired downdraft kilns, shuttle kilns, and tunnel kilns. As soon as supply of natural gas becomes available in Khurja through pipelines, it would be possible to use gas fired-kilns as well. The kilns use light diesel oil (LDO), diesel oil, coal, and gas as fuel. Although temperature is monitored, there are no automatic control systems installed in these kilns to monitor the air–fuel ratio, and thus, control the firing. Due to erratic power supply, the units depend on locally made diesel-operated generators. The average specific energy consumption (SEC), that is, the energy consumed per kilogram of the finished product was as follows.

i. For LDO/ HSD fired kilns: 0.11–0.3 litre per kg of product output
ii. For coal-fired kilns: 1.75 –2.25 kg of coal, per kg of product output

This provides a clear indication that the average SEC in the Khurja ceramics and pottery cluster has potential for improvement in the range of 20%–25%, provided changes are made in operational and maintenance practices and retrofit investments. Saving on fuel can simultaneously be raised to 25%–35%, if technology upgradation options and fuel switch options (from oil to gas) are adopted.

The Khurja pottery cluster is expecting to gain access to natural gas from the nearby gas pipeline, located 18 km away. M/s Adani Group has undertaken the task to extend the gas pipeline up to Khurja. The units have also indicated their willingness to invest in necessary arrangements for switching over to gas as fuel in the cluster. Gas firing will not only reduce costs and make finished products from the units more competitive, many firms are of the opinion that gas firing will also enable them to diversify into manufacturing porcelain tableware. It is believed that there is a huge market for porcelain tableware that is still not manufactured on a large scale in India. Gas, being a cleaner fuel and also free of impurity, also enables better control over temperature. A switch to gas does not entail major modifications to the current kilns, only a change in the burner system. Given the higher calorific value of gas per unit cost, such a shift will result in lowering the energy cost of units that make the switch. At the same time, it will also reduce emission from the kilns.

d) The kiln furniture being primarily used at the cluster includes non-standard saggers, decker plates, and trolleys. The heat absorbed by the furniture is one of the main concerns for excessive energy consumption. To conserve heat inside the kiln, most of the units use ceramic fibre, HF-8 or other insulation systems. Fire bricks and insulation bricks are being used in downdraught kilns, which can be upgraded to ceramic fibre. However, due to poor quality of insulation material and below-par maintenance practices, heat losses are immensely high, leading to higher energy consumption. The sagger plates in use have higher product-to-deadweight ratio, approximately 1:2 or more, which can be reduced to a level of 1:1 or even lower.

e) To ensure quality of the product, mainly visual inspection is resorted to for all the processes—from preparation of clay to packaging. Seasoned craftsmen use their experience to adjudge consistency of ingredients while preparing clay, for maintaining firing temperatures inside the kilns, and while employing the ‘sound test’ (hitting crockery parts together to check for cracks). The rate of rejection is quite high at each stage.

f) The area available in most of the units is lesser than what is ideally required. Moreover, barring a few units, housekeeping is poor due to the following reasons.
    i. Poor shop floor layout
    ii. Space constraint
    iii. Large area needed for natural drying
    iv. Mixed-up storage area for raw material, greens, and finished products
    v. Dust in material storage and handling areas

vi. Poor aisle and movement space, due to which green materials fall and break and, hence, are discarded
vii. Poor drainage and waste disposal arrangement in and around the units

g) To meet the stipulated norms, the units have obtained pollution under control (PUC) certificates from the Local Pollution Control Board on various effluents generated during the manufacturing process. Most units belonging to the Khurja pottery and ceramics cluster have never got a systematic energy and environment audit conducted. Moreover, the units have not been exposed to training on issues related to energy and environment management.

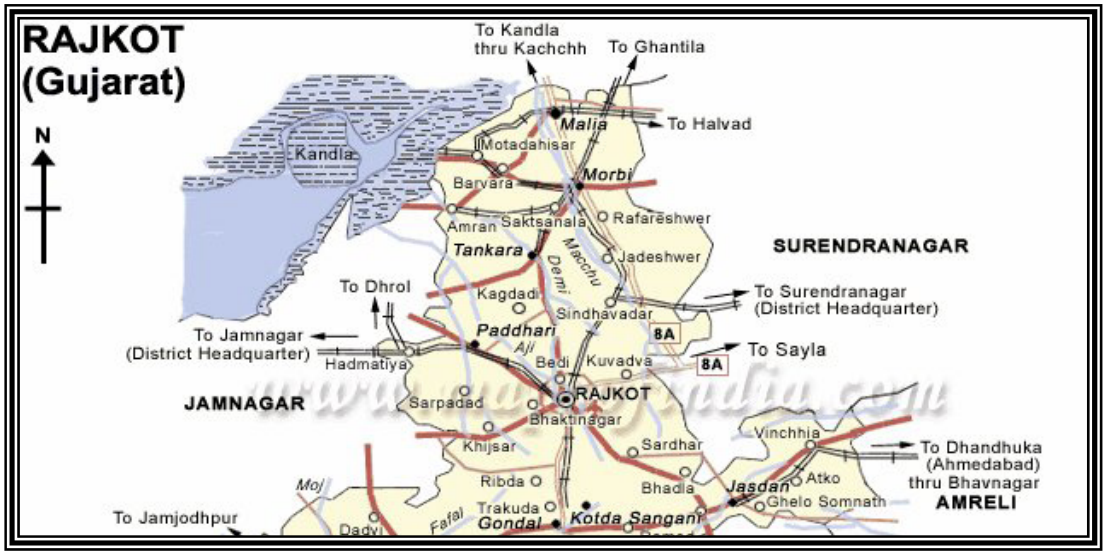
There is a possibility of reducing gaseous emissions (mainly carbon dioxide), and recycling and using wastewater and rejects discarded to the landfill sites. However, lack of knowledge and training in recycling and pollution control act as major hindrances in this regard.

h) All the units that were studied are managed by owners or family members. There are generally one to three family members (father and sons/brothers) who take care of all aspects of managing the unit (raw material procurement, production, finance, marketing, and so on). The units will continue to function under similar structure in the future. Generally, the first-generation entrepreneur (father) has a bachelor's degree, whereas the second generation (son) has a professional graduate/post-graduate qualification, and is more open to modern management techniques for better profitability.

i) Khurja has about 10 services providers (See Annexure7) involved in the construction and maintenance of kiln, servicing of burners, maintenance of ball mill, DG sets, and electrical appliances. Consultancy services for kiln design, ensuring product quality to meet export requirements for units desiring such services are provided by CGCRI and other freelance consultants. Transportation of both raw material and finished products is out sourced through transport agencies and/or transport contractors.

Morbi cluster: structure and technology status[6]

Morbi is located in Rajkot district of Gujarat. It lies 210 km from Ahmedabad, and approximately 65 km from Rajkot. Proximity to the Navalakhi port provides a great advantage for exports.



a) Morbi has about 400 ceramic units of various capacities and product categories. The units studied in Morbi are financially sound and are doing reasonably well, both in domestic and international markets. They have systems and technology in place to maintain product quality standards. Entrepreneurs of the region display keenness for technology upgradation. Products are marketed all across the country. Some units even export their products overseas, either directly or through agents. There are factory showrooms, dealer showrooms, traders, and intermediaries. Marketing strategies are usually unit-oriented, and directly handled by somebody from the senior management or by family members.

   Typical production levels for the ceramic manufacturing units vary from 70–1800 MT per month for sanitary ware, and 180–4500 MT per month for ceramic tiles.

b) The main items produced by the cluster are sanitary ware, and ceramic floor, and wall tiles. Few units in Morbi manufacture other ceramic items as well. Raw materials being used in the cluster include clay, stone, and quartz (from various parts of Rajasthan and Gujarat). Types of clay used include china clay, plastic ball clay, fire clay, and than clay. Impurities in the raw materials result in defects in the preparation of greens, and also hamper the quality of final products. Units that are ISI certified do practice testing of raw materials. However, it is essential that other units, too, adopt the procedure of testing the incoming raw materials.

[6] Diagnostic Study Report for Ceramics Cluster at Morbi. (Prepared by Shri Shakti Alternative Energy Ltd Hyderabad, India)

All the units studied in the cluster have raw-material processing facilities. Major equipments in material processing include primary and secondary crushers and ball mills, blunger, agitators, magnetic sieve separators, and filter press among others. In addition to the quality of the incoming raw materials, processing of raw materials also play a significant role in the quality of the final products.

c) The various types of kilns operational in Morbi are generally tunnel kilns for sanitary ware and roller kilns for ceramic tiles, though there are a few exceptions. The roller kilns used for manufacturing tiles have computer-based firing control where the temperature profile is preset. On the other hand, the tunnel kilns have manual control. Some of the units have a timer-based alarm for kiln car movement. However, due to knowledge barrier, the units lack in analysing the gathered data and taking appropriate corrective measures.

The units manufacturing sanitary ware use liquid fuel (mixed oil/C-9) for the tunnel kiln. The tile manufacturing units have spray dryers that use *putri* (groundnut shell), an agri-waste, as fuel. The tile manufacturing units use liquid fuels or coal-based producer gas for biscuit-stage firing and/or coloured floor tiles where the effect due to impurities in producer gas is minimal on the finished product.

Majority of the tile manufacturing units were using roller kiln for production of floor and wall tiles. Specific coal consumption is 0.179 to 0.24 to 0.2 kg/kg of finished product (800–1100 kcal/kg) for units using coal-based gas. Two units used roller kilns with oil as fuel. In these instances, specific fuel consumption was 0.28 litre/kg (2380 kcal/kg), while two units used LPG with specific fuel consumption of 0.19 kg/kg (2200 kcal/kg).

With pipelines being laid nearby, the Morbi cluster is anticipating access to natural gas. Gas firing will reduce costs and will also make the product more competitive. The switch to natural gas does not require any major modification, except for burners and gas piping.

d) Some units use branded cordierite kiln furniture. Others use saggers, and at times, a combination of both. Since the energy needed to fire kiln furniture is often quite high, the most recent trend is to manufacture lighter kiln furniture that consume less heat and are more fuel efficient. Usually, the ratio of product weight to kiln furniture weight is as high as 1:2. This can be reduced to 1:1.5 or even 1:1 by using advanced silicon carbide or advanced nitride-bonded silicon carbide materials.

e) For sanitary ware, the units in Morbi are drying the greens naturally in the open. Some units have tried using the waste heat for driers. However, this procedure does not seem to be working and needs improvement (piping, blower, and the like). Few advanced large-scale units in India (like Hindustan Sanitaryware, Parryware, and others) are already using hot-air chambers to dry the greens before firing.

Roller kilns have dryers attached to them for drying the ware before firing. They also have the facility to use waste gas from the kiln or have additional burners for drying.

f) All units get power from the Paschim Gujarat Vij Company Ltd (PGVC). The power supply is generally stable and reliable. The units also have adequate capacity of standby DG sets that are used only for emergency purposes.

   Specific electricity consumption of the units varies from 0.08–0.15 kWh /kg of product. Larger units have lower specific energy consumption.

g) All units are close knit and are managed by family/close friends. Each member concentrates on one area, that is, marketing or production or finance and so on. Some of them have prior exposure to advanced management techniques. Manpower costs are low, but the skills of locally available supervisors are rather limited. There is a need to increase their exposure to scientific methods of manufacturing, industrial engineering techniques, training, and so on.

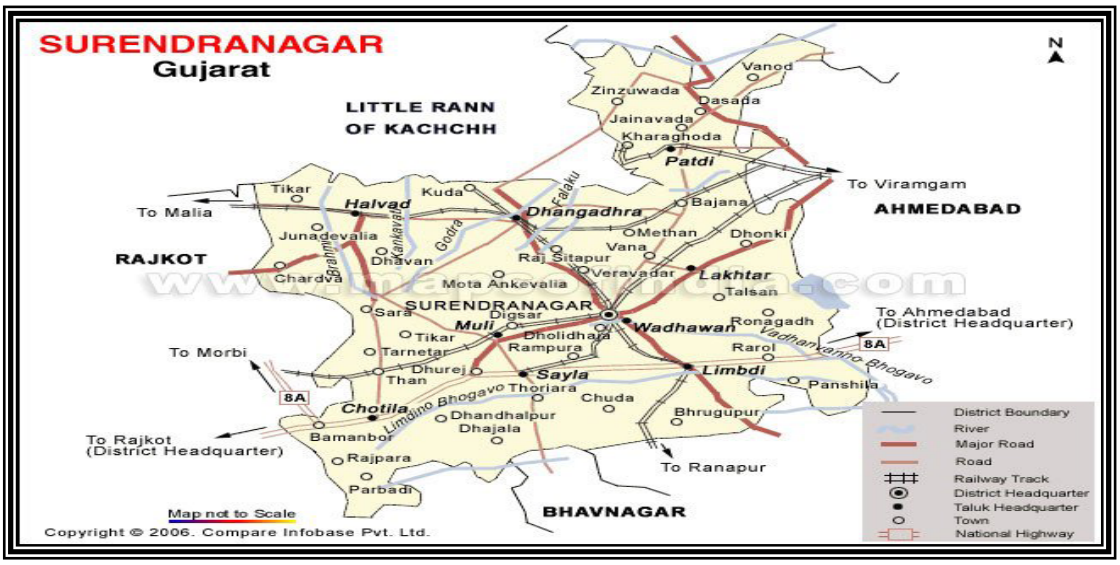
h) All units studied have access to information on advanced technologies. However, the information needs to be systematically evaluated and transformed to facilitate decision-making by the management, and for implementation at the shop-floor level.

i) Morbi has some service providers involved in construction and maintenance of kiln, servicing of burners, and maintenance of ball mill, DG sets, and electrical appliances. Consultancy services for kiln design, biomass gasifiers, and quality systems are availed of from consultants based in Ahmedabad or Rajkot. Transportation of both raw material and finished products is outsourced through transport agencies and/or transport contractors.

j) Other observations
   - The units have no scientific data on the amount of wastage/rejects generated during the manufacturing process stages. The usual proportion is about 10%, with most of the wastage/rejects occurring before the firing stage. Loss of about 5%–6% occurs in shaping, and the remaining in glaze/handling, and so on. The firing losses are about 1.5%–2% (1% during drying stage up to 150 ˚C; 0.2% in handling during unloading; and the balance due to dust, crawling, glaze, and so on).
   - Most of the units have requisite clearances/consents from the Pollution Control Board (PCB).
   - A majority of the units have ISO/IS certification for the plant/product.
   - Some of the larger units employ more than 100 workers and supporting staff. Medium sanitary ware units have 15–20 skilled and semi-skilled workers.
   - Since energy audit is mandatory for larger units, such units have got the audit conducted and have initiated energy conservation measures. The ISO-certified units also undertake measures to control pollution as per the stipulations.
   - Most of the units have exposure to international trade fairs/exhibitions, both in India and abroad. Foreign players (Chinese/Italians) regularly visit Morbi for trade enquiries/service contracts.

Thangadh cluster: structure and technology status[7]

Thangadh, located in Surendranagar district of Gujarat, lies at a distance of 160 km from Ahmedabad. Its proximity to Navalakhi port is hugely advantageous for exports. The cluster is older than Morbi. The units here primarily manufacture sanitary ware.



a) Thangadh has about 200 ceramic units of various capacities and product categories. While some of these units are not operational, most of the functional units are financially sound, and are doing reasonably well, both in domestic and international markets. Some of them have put systems in place to maintain product quality standards. The units market their products all across the country. Some of them even export their products overseas. There are factory showrooms, dealer showrooms, traders, and intermediaries.

   For sanitary ware, the typical production levels for the ceramic manufacturing units vary from 70–1000 MT/month.

b) The main item produced by the cluster is sanitary ware. Few units manufacture other ceramic items as well, such as gift items, LT electric insulators, small ceramic statues, and crockery. Raw materials used in the cluster include clay, stone, and quartz (from various parts of Rajasthan and Gujarat). The types of clay used include china clay, plastic ball clay, fire clay, and than clay. Impurities in the raw materials result in number of defects in the preparation of greens, and also adversely impact the quality of final products. While the ISI-certified units have the practice of testing raw materials, it is essential that other units, too, adopt this procedure.

   The units have raw material processing facilities that are required in manufacturing. Important equipments in material processing include primary and secondary crushers and ball mills, blunger, agitators, magnetic sieve separators, filter press, and so on. In

[7] Diagnostic Study Report for Ceramics Cluster at Thangadh. (Prepared by Shri Shakti Alternative Energy Ltd Hyderabad, India)

addition to the quality of the incoming raw materials, processing of raw materials also plays a significant role in determining the quality of the final products.

c) Kilns in Thangadh are generally tunnel kilns for sanitary ware and shuttle kilns for smaller products. The kilns are manually controlled. Some units have timer-based alarm for kiln car movement.

   Majority of the units manufacturing sanitary ware uses liquid fuels (mixed oil/C-9) for the tunnel kiln.

   With gas pipeline being laid nearby, the Thangadh cluster is anticipating gaining access to natural gas. Gas firing will reduce costs and will also make the products more competitive. Moreover, the switch to natural gas does not require any major modification, except for burners and gas piping.

d) Some units use branded cordierite kiln furniture. Others use saggers, and at times, a combination of both. In general, energy needed to fire kiln furniture is quite high.

   Hence, the recent trend is to manufacture lightweight kiln furniture, which consumes less heat and, hence, is more fuel efficient. The ratio of the product weight to the kiln furniture weight ratio is as high as 1:2. This can be reduced to 1:1.5 or even 1:1 by using advanced silicon carbide or advanced nitride-bonded silicon carbide materials.

   All units are drying the greens naturally in the open.

e) All units get power from the Paschim Gujarat Vij Company Ltd (PGVC). Even though the power supply is stable and reliable, all units have adequate capacity of standby DG sets. The generators are used only for emergency purposes.

   The specific electricity consumption of the units varies from 0.08–0.15 kWh/kg of product. Larger units have lower specific energy consumption.

f) All units are closely knit and managed by family/close friends. Manpower costs are low, but the skills of locally available supervisors are rather limited. There is a need to undertake capacity-building of the supervisors by exposing them to the scientific methods of manufacturing and industrial engineering techniques, providing them with relevant training, and so on.

g) As compared to Morbi, Thangadh depends on relatively advanced service providers (See Annexure7) for construction and maintenance of kiln, servicing of burners, maintenance of ball mill, and so on. Some of the consultancy services for kiln design, biomass gasifiers, and quality systems are availed from consultants based in Ahmedabad and Rajkot. Transportation of both raw material and finished products is outsourced through transport agencies and transport contractors.

   Other observations

   - The units have little or no data on the amount of wastage/rejects during the various stages of the manufacturing process. The proportion of

wastage/rejects is generally expected to be about 8%–10%, with most of it occurring before the firing stage. The loss incurred during shaping is about 4%–5%, while the rest occurs in glaze/handling, and so on. Firing losses are about 1.5%–2% (1% during drying stage, up to 150 ˚C; 0.2% in handling during unloading; and the balance due to dust, crawling, glaze, and so on).

- Some units have come up with arrangements to recycle the waste product. About 50% of the fired waste is recycled by such units and supplied to the units manufacturing the sanitary ware.
- Most of the units have requisite clearances/consent from the PCB.
- Majority of the units have ISO/IS certification for the plant/product.
- Larger units have more than 60 workers and supporting staff, while the medium-sized sanitary ware units employ 15–20 skilled and semi-skilled workers. Smaller units have 8–10 workers.
- Energy audit has been conducted at the larger units. These units have also initiated energy conservation measures. The ISO-certified units undertake measures to control pollution as per stipulation. Very few units have exposure to international trade fairs/exhibitions, be it in India or abroad.

4.3.2 Selective units

The project document provided for identifying 10 selective units. However, when it was decided that programme interventions would be carried out in three clusters, instead of two, as was originally envisaged, 15 ceramic units were identified in the three clusters. Accordingly, eight representative ceramic units from Khurja, four from Morbi, and three from Thangadh were selected in consultation with the local industry associations for demonstrating the performance of the energy-efficient technologies, standardization of the raw materials and quality processes, and so on. The selective units in each of the three clusters were representative in terms of product, technology status, and size of the units. Based on the recommendations of the diagnostic studies, major areas of interventions were identified and a plan of action initiated, in consultation with national experts, cooperating institutions and local associations, for technological upgradation of the selected units through adaptation of energy-efficient technologies and their demonstration.

The following key activities were taken up for the selected units in order to achieve the projected outcome.

4.3.2.1 Awareness programme on improving energy efficiency

Since energy cost accounts for 25%–30% of the total production cost, thereby making the manufacturing process of ceramic products highly energy intensive—attaining energy efficiency was chosen as the main objective of the programme. Production processes in ceramic units are energy intensive. About, 25%–30% of cost of production is on account of fuel and other energy needs. According to initial estimates, if appropriate measures are adopted, energy savings in ceramic units could be as high as 20%–25%.

Implementation of energy-efficient technologies and policies can, therefore, help ceramic units become more competitive and productive.[8]

However, when it came to the role of improved and energy-efficient technologies and processes in enhancing productivity and cost competitiveness, awareness levels varied widely across the three clusters. Accordingly, the programme was launched with a series of meetings and workshops at all three clusters.

On completion of the programme, its aim, activities, and expected results were explained to the ceramic units and industry associations of Khurja, Morbi, and Thangadh through presentations during field visits and interaction meetings with stakeholders during July/August 2005. A workshop of stakeholders was organized at Khurja on 28 December 2005. The awareness campaign succeeded in convincing the units about the merit of the programme and motivated them to participate. The units responded favourably and owned the activities through substantial financial contribution in each.

Keeping in mind the significance of energy-efficient technologies and policies in making ceramic units more competitive and productive, the programme focused on introducing and demonstrating energy-efficient technologies and processes, undertaking energy audit, improving quality standards, and establishing market linkages.

4.3.2.2 Energy audits

Energy audits of the eight selective units at Khurja, four at Morbi, and three at Thangadh were conducted by SSAEL of Hyderabad, Andhra Pradesh, during June–July 2006. The objective was to understand the present status of energy consumption, technology-in-use, feasible opportunities to conserve energy consumption in the selected ceramic units on the above points, identifying problems/bottlenecks/constraints/issues, suggesting solutions to problems, and recommending an action plan for each unit for follow-up in the project.

Approach and methodology for energy audits[9]

The list of units at Morbi, Thangadh, and Khurja clusters for which energy audits were to be conducted were finalized by the project team in consultation with the respective local industry associations. Selection of the units was based on the comprehensive criteria outlining their capacities, energy-efficiency improvement potential, and keenness to be part of the UNIDO project.

The energy audit team adopted the following approach and methodology to conduct the energy audits.

Walk-through audits: The energy audit team visited the facility to familiarize itself with the process variables. It collected secondary data from units by conducting interviews with the management and staff, and from records/bills available on energy consumption (fuel bills, electricity bills, and so on).

[8] Project Document on "National Programme to Support Energy Efficiency and Quality Standards in Ceramic Industries", signed in October 2004, page no. 1

[9] Diagnostic Study Report for Ceramics Cluster at Thangadh; Diagnostic Study Report for Ceramics Cluster at Morbi; Diagnostic Study Report for Khurja Pottery and Ceramics Cluster, February 2007. (Prepared by Shri Shakti Alternative Energy Ltd Hyderabad, India)

Analysis of secondary data and planning for detailed audit: Analysis of the secondary data was conducted to chalk out a strategy for a detailed audit at the facility. The analysis brought to the fore the significant energy-consuming areas, where the process variables needed to be measured for defining the baseline energy consumption and validation of the secondary data. The trends on the SEC were also analysed. Frequency of measurements for significant process variables affecting the SEC was also decided.

Detailed audit: The key areas covered in the detailed energy audit included collection, collation, and analysis of data on the following.

1. Raw material preparation and handling
2. Firing and hardening of by-products and effluents
3. Evaluation of status of furnace technology, fuel consumption, and benchmarking

Based on analysis of the aforementioned data, baseline SEC was formulated for internal benchmarking and was compared with norms within the selected class of industry.

An action plan has been drawn for individual units indicating measures that can be implemented to realize energy conservation potential in kilns, standby power generation equipment, transmission, and distribution. Each of the selective units was provided with a copy of the detailed energy audit report.

Energy audit highlights[10]

The highlights of the energy audit for each selective unit are as follows.

Khurja cluster

Anupam Pottery Works: Energy Audit Highlights	
Location	Khurja, Uttar Pradesh
Year of commencement	1971
Product	Insulators (HT and LT)
Production capacity	300 MT for LT and 10 MT for HT Insulators
Date of energy audit	June 2006
Kiln details	
Kiln type	Downdraft kiln
Insulation	Refractory bricks
Fuel used	Coal; landed cost Rs 5500 /MT
Specific fuel consumption	1.00 kg/kg of the product
Cost of coal for kiln	Rs 1.705 million per year
Electrical and standby power consumption	
Electrical load	15 kW
Electricity consumption	1200 kWh/month
Per unit price of electricity	Rs 4.10 /kWh
Cost of electricity from SEB	Rs 0. 06 million per year
Standby DG sets	2 no.s of 7.5 kVA, and 1 No. of 60kVA
HSD consumption	3 litre /hour
Cost of HSD for DG Sets	Rs 0.12 million per year
Energy conservation measures already initiated by the firm	
None	
Key observations and recommendations	
Raw material preparation and greening stage Presently, there is no data on moisture content of clay that is purchased. It is recommended to test the raw material and accept clay that has moisture content of 2%. The clay should conform to the specifications of IS 2400-1965 and Feldspar as per IS: 9749-1981. **The ratio of charge:grinding media:water should be 1:1.1:0.6. The moisture in the greens before firing is to be tested as any additional water content means more energy consumption and cycle time (test procedures to check moisture content in clay and greens are given in the energy audit report).**	
Firing: kiln technology and efficiency	

[10] Diagnostic Study Report for Ceramics Cluster at Thangadh; Diagnostic Study Report for Ceramics Cluster at Morbi; Diagnostic Study Report for Khurja Pottery and Ceramics Cluster, February 2007. (Prepared by Shri Shakti Alternative Energy Ltd Hyderabad, India)

The major reasons for energy wastages are

- Improper fuel preparation and sizing of coal
- Improper firing techniques with inefficient combustion
- No air control, resulting in lot of excess air
- Emission of black smoke, as and when the coal is fired

Taking into consideration the small batch size and low production, it would be economically unviable to adopt automated temperature control technologies.

Proper wetting and fuel preparation is one of the best ways to reduce fuel consumption and, hence, improve energy efficiency without any major investment.

Alternatively, the use of tunnel kiln in place of existing downdraft kiln will save about Rs 0.3 million per year

Recommendations and savings: kiln

S. No.	Energy-Efficiency Measure (EEM)	Savings in fuel (kL/year)	Value of savings (Rs/Annum)	Investment (Rs)
1.0	Proper coal preparation	28	140 000	110 000
2.0	Provision of ceramic fibre insulation	25	125 000	400 000
3.0	Upgradation to oil-fired tunnel kiln	-	300 000	1 800 000
	Total	53	565 000	2 310 000

The unit can opt for coal/biomass gasifier or go for natural gas, but the investment economics at current production levels do not favour the fuel switch option.

Electrical energy consumption

The power supply from the SEB is very limited (8–10 hours per day). Hence, the unit depends on backup DG sets. The unit uses locally-made 60 KVA, and 7.5 KVA (2 No.s) reconditioned DG set. Since the DG sets are small, there are no recommendations in this regard.

The unit could consider replacing the existing DG sets with branded DG sets to save on HSD consumption. Use of biomass gasifier for power generation is not recommended as the usage of DG sets is quite low.

Most electrical motors are rewound. It is recommended to replace the rewound motors with new energy-efficient motors in a phased manner. The savings are not quantified, as electricity consumption amounts to only Rs 0.12 million per year.

Benchmarks and target fuel consumption

Particulars	Present	Target
Specific Fuel Consumption: kiln (kg/kg)	1.00	0.70

Implementation approach

Based on the discussions with the unit's management, it is felt that there is a need to work with them for implementing the EEMs. Following is the support that may be required by the unit for implementation of the EEMs.

- Work with them to monitor and benchmark energy.
- Detailed engineering for recommendations (where required, for example, dryer), taking into consideration layout and operational constraints.
- Assistance in vendor identification, and selection and overseeing proper implementation
- Post-implementation measurement and verification of savings

Daya Ceramics: Energy Audit Highlights	
Location	Khurja, Uttar Pradesh
Year of commencement	1973 (initially); purchased by the present owners in 2002
Product	Crockery
Production capacity	1750 MT/Year
Date of energy audit	June 2006
Kiln details	
Kiln type	Tunnel kiln (114' long), four burners, Wesmann make
Insulation	Refractory and ceramic fibre
Fuel used	HSD; landed cost Rs 35 /litre
Specific fuel consumption	Not available
Cost of HSD for kiln	Rs 5.565 million per year
Electrical and standby power consumption	
Electrical load	20 kW
Electricity consumption	6000 kWh/month
Per unit price of electricity	Rs 4.10 /kWh
Cost of electricity from SEB	Rs 0.295 million per year
Standby DG sets	40 KVA and 60 KVA
HSD consumption	80 litre/day
Cost of HSD for DG Sets	Rs 6.7 million per year
Energy conservation measures already initiated by the firm	
No significant energy-saving measure initiated in the recent past. Would like to initiate some measures under expert guidance.	
Key observations and recommendations	
Raw material preparation and greening stage Only visual quality checks performed during the process from raw material to firing. ❖ It is recommended to test the raw material (clay) and accept clay with moisture content of 2% (testing method is provided in the detailed energy audit report for the unit). ❖ The clay should conform to the specifications of IS 2400-1965 and Feldspar as per IS: 9749–1981. ❖ The ratio of charge: grinding media: water should be 1: 1.1: 0.6.	
Firing: kiln technology and efficiency The unit is using tunnel kiln with a daily fuel consumption of 500–530 litre of HSD. ❖ At 15%, the oxygen content in the exhaust is high. It has to be reduced to 10% by monitoring the same through a flue gas analyser, and by providing and adjusting the damper at the chimney base. It is recommended to provide manometer pockets along the length of the kiln for pressure measurements to maintain the required pressure profile by adjusting the damper. The details are provided in the energy audit report. ❖ The exhaust temperature has to be maintained at about 200–210 ^{0}C (283 ^{0}C measured in audit) using a thermocouple sensor with temperature indicator and adjusting the chimney damper and/or burner damper. ❖ Burner efficiency can be improved by using low excess air burners and providing a	

simple automatic control to switch off the burners at the set point temperature.

- ❖ The kiln has a common blower to supply air to the burners for combustion and for the cooling zone of the kiln. It is recommended to provide separate blowers for combustion air and for cooling zone of the kiln.
- ❖ Waste heat recovery from chimney exhaust can be used for drying the green product prior to firing in the kiln.
- ❖ The unit can use advanced nitride bonded silicon carbide material for kiln furniture. This will improve the ratio of product mass to kiln furniture. The economics and savings of the recommendations pertaining to the kiln are given below.

Recommendations and savings: kiln

S.No.	EEM	Savings in fuel (kL/year)	Value of savings (Rs/Annum)	Investment (Rs)
1	Reduce excess air in the present operation	5	175 000	110 000
2	Improvements to combustion system (blower, burner, and automation)	22.5	787 000	800 000
3	Lightweight kiln furniture	3.29	115 000	225 000
	Total	30.79	1 077 000	1 135 000

The unit can opt for natural gas as fuel for the kiln (when NG pipeline infrastructure becomes available), which will save Rs 1.575 million annually with an investment of Rs 1 million for piping and burners.

Energy savings: electrical energy and standby power

Power supply from the SEB is very limited (8–10 hours per day). So, the unit depends on back up DG sets. The unit uses locally-made 60 KVA and 40 KVA reconditioned DG set. It is recommended to install a voltage stabilizer and maintain voltage at 415V.

S. No.	EEM	Savings in fuel	Savings (Rs/Yr)*	Investment (Rs)
1.	Voltage control in electrical system	Not quantified		
2.	Use of biomass gasifier and gas engine to replace DG set		512 000	1 800 000

* Details of the calculations are given in the Annexure to the energy audit report.

Benchmarks and target fuel consumption

Particulars	Present	Target
Specific fuel consumption: kiln (lts/kg)	0.14	0.11
Specific energy generation: kWh/litre	Estimated at about 1.5	2.2

Implementation approach

The management of the unit felt that they need support for implementation of EEMs, as they do not have qualified technical personnel for the same.

Following is the support required by them.

- Work with them to monitor and benchmark energy
- Work with them to detail the recommendations and selection of EEMs
- Assistance in vendor identification, and selection, and overseeing proper implementation
- Measurement and verification of savings after implementation

Gulati Ceramics: Energy Audit Highlights	
Location	Khurja, Uttar Pradesh
Year of commencement	2002/2003
Product	Bone china
Production capacity	5 MT/day
Date of energy audit	June 2006
Kiln details	
Kiln type	Tunnel kiln (120' Long), six burners, Wesmann make
Insulation	Ceramic fibre
Fuel used	High Speed Diesel (HSD); landed cost Rs 35 /litre
Specific fuel consumption	0.42 litre/kg of the product
Cost of HSD for kiln	Rs 21.168 million per year
Electrical and standby power consumption	
Electrical load	30 kW
Electricity consumption	9000 kWh/month (not recorded)
Per unit price of electricity	Rs 4.10 /kWh
Cost of electricity from SEB	Rs 0.443 million per year (not recorded)
Standby DG sets	63 KVA
HSD consumption	100 litre per day
Cost of HSD for DG Sets	Rs 1.050 million per year
Energy conservation measures already initiated by the firm	
➢ Temperature monitoring at nine zones ➢ Use of branded kiln furniture and cordite sagger plates ➢ Capacitors for power factor control	
Key observations and recommendations	
Raw material preparation and greening stage Usually, the quality of raw material is not monitored. Moisture content in the raw material and quality of the raw material has a bearing on the final quality of the product. It is recommended to monitor the moisture in purchased ball clay, and only accept clay with moisture content of 2%. Also, the ratio of charge : grinding media : water should be 1 : 1.1 : 0.6 Other means of reducing wastage include discarding the defective moulds and using properly shaped moulds as well as employing minimum water in the jolly while touching up the product in its finishing stage.	
Firing: kiln technology and efficiency The daily fuel consumption of the tunnel kiln is 2000 litres of HSD. The oxygen content in the exhaust is high at 18%, which can be reduced to 10% by monitoring the same through a flue gas analyser, and adjusting the damper at the chimney base. The exhaust temperature has to be maintained at about 200–210 ^{o}C. The measured temperature during the audit was 178 ^{o}C. This is because the flue gas was not fully exhausting through the chimney; part of it was exhausting through the front-end opening of the furnace, and also air ingress. This was shown to the management and the kiln designer of the unit. This can be controlled by using a thermocouple sensor with temperature indicator, and adjusting the chimney damper and/or burner damper. It is recommended to provide manometer pockets along the length of the kiln for pressure measurements to maintain	

the required pressure profile by adjusting the damper. The details are given in the energy audit report.

Efficiency of the burner can be improved by the use of low excess air burners and providing a simple automatic control to switch off the burners at the set temperature. The kiln has a common blower to supply air to the burners for combustion and for the cooling zone of the kiln. It is recommended to provide separate blowers for combustion and for the cooling zone. The waste heat recovery from the chimney exhaust can be used for drying the green product. The unit can use advanced nitride bonded silicon carbide material for kiln furniture to improve the ratio of product mass to kiln furniture. The economics and savings of the recommendations pertaining to the kiln are as follows.

Recommendations and savings: kiln

S. No.	EEM	Savings in fuel (kL/year)	Value of savings (Rs/Annum)	Investment (Rs)
1	Reduce excess air in present operation	20	700 000	200 000
2	Improvements to combustion system (blower, burner, and automation)	90.75	3 176 000	1 125 000
3	Light weight kiln furniture	8.94	313 000	400 000
	Total	119.69	4 189 000	1 725 000

The unit can opt for natural gas as a fuel for the kiln (when NG pipeline infrastructure becomes available), which will save Rs 6.352 million with an investment of Rs 1 million for piping and burners.

Electrical-energy consumption

The PVVN power is available only for about 8–10 hrs per day, and the balance power supply is drawn from the DG sets. The unit uses a locally-made 60 KVA DG set.

DG set	EEM	Savings in fuel	Savings (Rs/Yr)	Investment (Rs)
1	Use of biomass engine to replace HSD		614 000	1 800 000
	or			
	Use of branded DG sets for better fuel economy	`	588 000	800 000

* Details of the calculations are given in the Annexure to the energy audit report.

Benchmarks and target fuel consumption

Particulars	Present	Target
Specific fuel consumption: kiln (l/kg)	0.42	0.35
Specific energy generation: kWh/L	Not monitored, expected to be about 1.5	2.2

Implementation support

The management would like

- Assistance in monitoring and benchmarking energy, as these are completely new to them.
- Detailed engineering for recommendations (where required, that is, dryer) taking into

consideration layout and operational constraints.

- Vendor identification and selection, and overseeing proper implementation to realize the energy savings.

Naresh Potteries: Energy Audit Highlights	
Location	Khurja, Uttar Pradesh
Year of commencement	1974
Product	HT & LT Insulators
Production capacity	180 MT/month
Date of energy audit	June 2006
Kiln details	
Kiln type	Tunnel kiln (120' Long), four burners, Wesmann make
Insulation	Ceramic fibre
Fuel used	High Speed Diesel (HSD); landed cost Rs 35/litre
Specific fuel consumption	0.11 litre /kg of the product
Cost of HSD for kiln	Rs 7.875 million per year
Electrical and standby power consumption	
Electrical load	51 kW
Electricity consumption	10750 kWh/month
Per unit price of electricity	Rs 4.10 /kWh
Cost of electricity from SEB	Rs 0.529 million per year
Standby DG sets	63 KVA, 50 KVA, and 7.5 KVA
HSD consumption	72 kL/year
Cost of HSD for DG Sets	Rs 2.52 million per year
Energy conservation measures already initiated by the firm	
➢ Temperature monitoring at nine zones in the kiln ➢ Use of branded kiln furniture and cordite sagger plates ➢ Capacitors for power factor control ➢ Extended the kiln with a drying zone and provided a separate LPG burner for drying green product	
Key observations and recommendations	
Raw material preparation and greening stage ➢ It is also recommended to test the raw material (clay) and accept clay with moisture content of 2% (testing method is given in the detailed energy audit report for the unit). ➢ Wastage can also be reduced by doing material balance from raw material and green stage as explained in the energy audit report. ➢ The recommended ratio of charge:grinding media:water is 1 : 1.1 : 0.6	
Firing: kiln technology and efficiency ➢ The unit is using tunnel kiln with a daily fuel consumption of 500–700 litre of HSD. The oxygen content in the exhaust is high at 17.2%, which has to be reduced to 10% by monitoring the same through a flue gas analyser and adjusting the damper at the chimney base.	

- The exhaust temperature has to be maintained at about 200–210 ^{o}C (238 ^{o}C measured in audit) using a thermocouple sensor with temperature indicator, and adjusting the chimney damper and/or the burner damper.
- It is recommended to provide manometer pockets along the length of the kiln for pressure measurements to maintain the required pressure profile by adjusting the damper. The details are given in the energy audit report.
- Burner efficiency can be improved by using low excess air burners and providing a simple automatic control to switch off the burners at the set temperature.
- The kiln has a common blower to supply air to the burners for combustion and for the cooling zone of the kiln. It is recommended to provide separate blowers for combustion and the cooling zone.
- Waste heat recovery from chimney exhaust can be used for drying the green product prior to firing in the kiln.
- The economics and savings of the recommendations pertaining to the kiln are as follows.

Recommendations and savings: kiln

S. No.	EEM	Savings in fuel (kL/year)	Value of savings (Rs/Annum)	Investment (Rs)
1.	Reduce excess air (maintain O_2 at 10% in exhaust)	7.5	262 000	110 000
2.	Improvements in combustion system (low excess air burners, separate blowers for combustion and cooling, and automatic control)	26.5	596 000	800 000
3.	Waste heat recovery (for product drying to replace LPG burner)	12.0	320 000	500 000
	Total	46.0	1 178 000	1 300 000

The unit can opt for natural gas as fuel for the kiln (when NG pipeline infrastructure becomes available), which will save Rs 1.789 million every year with an investment of Rs 1 million on piping and burners.

Energy savings: electrical energy and standby power

Power supply from the SEB is very limited (8–10 hours per day). So, the unit depends on backup DG sets. The unit uses locally-made 60 KVA, 40 KVA, and 7.5 KVA reconditioned DG sets. Two options have been recommended for savings in this area, as given below.

DG Set	EEM	Savings in fuel	Savings (Rs/Yr)	Investment (Rs)
Option A	Replace with a new branded DG set	14.00 kL/yr	490 000	450 000
Option B	Use of biomass gasifier, gas engine, and new alternator to replace the DG set		1 132 000*	1 800 000

* Details of the calculations are given in the Annexure to the energy audit report.

Benchmarks and target fuel consumption		
Particulars	**Present**	**Target**
Specific fuel consumption: kiln	0.13 litre/kg	0.11 litre/kg
Specific fuel consumption: DG sets	Not monitored, estimated at 1.5 kWh/L of HSD	2.2 litre/kg
Implementation approach		
The study tried to cover the client's expectations to the maximum extent. Naresh Potteries has shown keen interest to reduce energy consumption and has expressed desire for a hand-holding approach towards effective implementation of the recommended energy saving measures. Absence of handholding was responsible for their failure to implement the energy audit recommendations earlier.		

Pratap Ceramics: Energy Audit Highlights	
Location	Khurja, Uttar Pradesh
Year of commencement	1989
Product	Artware / tobacco pipes and *hookahs*
Production	Highly dependent on order. 300–350 kg/batch
Date of energy audit	June 2006
Kiln details	
Kiln type	Shuttle kiln four burners, Wesmann make
Insulation	Insulation bricks
Fuel used	HSD; landed cost Rs 35/litre
Specific fuel consumption	0.58 litre /kg of the product
Cost of HSD for kiln	Rs 5.460 million per year
Electrical and standby power consumption	
Electrical load	10 kW
Electricity consumption	1000 kWh/month
Per unit price of electricity	Rs 4.10 /kWh
Cost of electricity from SEB	No record
Standby DG sets	7.5 KVA (2 nos.)
HSD consumption	3 litre/hour
Cost of HSD for DG sets	No record
Key observations and recommendations	
Raw material preparation and greening stage Presently there is no data on moisture content in clay that is being procured. It is recommended to monitor the moisture content before firing in the kiln. The moisture content should be as low as possible (less than 3%–5%). Every additional 1% moisture will consume 0.8% extra oil. Moisture can be tested by taking a weighed sample in a crucible and keeping it in an oven at 105 ^{o}C for 60 minutes. When the sample is weighed, the difference in weight is the water evaporated. It is recommended *to test the raw material* and accept clay that has moisture content of 2%. The clay should conform to the specifications of IS 2400-1965 and Feldspar as per IS: 9749-1981.	

Firing: kiln technology and efficiency

The shuttle kiln's fuel consumption per batch is 200–220 litre of HSD, and the production is about 300–350 kg/batch. The specific fuel consumption is 5730 kcal /kg or 0.58 l/kg of material fired. Since the unit is installing a tunnel kiln, the existing shuttle kiln was not studied.

The following recommendations were made for the to-be-installed tunnel kiln.

- Separate the blowers for combustion and cooling purposes. This will facilitate better control of combustion air for the burner and also the cooling air.
- The hot cooling air from the cooling zone of the kiln can be used in a controlled way by re-circulating it to the preheating zone. Dampers are to be provided for controlling air at the chimney outlet.
- Damper is to be provided at the suction side of the blower, In addition to the damper provided on the delivery side; suction-side damper would help in controlling the air flow and excess air.
- Use of low excess air burners. This has a better turndown ratio and operates on an excess air of 10%–15% with a properly designed burner block.
- Proper control of secondary air, instead of shutting it off completely. The provision of secondary air leads to better control of combustion.
- Use of HDPE pipes for air supply to the cooling zone. This will result in lesser pressure drop and will save energy. There is no corrosion.
- Use of butterfly valves (pipelines above 50 mm) in air lines, instead of gate valves, which have higher pressure drop.
- Provision of damper in the chimney to regulate excess air levels.
- Hot face ceramic fibre in the firing zone (250 mm for the roof and 200 mm for the side walls)
- Cold face ceramic fibre in preheating and cooling zone progressively reducing the thickness from 200 mm to 100 mm towards the cooling end.

Electrical energy and standby power

Power supply from the SEB is very limited (8–10 hours per day). The unit uses two locally made reconditioned DG sets of 7.5 KVA. It is recommended to install a voltage stabilizer and maintain voltage of grid power at 415V. The savings have not been quantified, as they are negligible. The use of voltage controller will also save on maintenance costs and improve the performance of the motor.

Benchmarks and target fuel consumption

Particulars	Present	Target
Specific fuel consumption – kiln (l/kg)	Not given, as the unit is shifting to tunnel kiln.	0.40

Implementation approach

The unit has shown keen interest to implement the recommendations in the new tunnel kiln that is being installed. A competent local consultant is taking care of the implementation. Additional hand-holding approach is desired to ensure that the recommendations are properly implemented.

Shiv potteries: energy audit highlights	
Location	Khurja, Uttar Pradesh
Year of commencement	2000
Product	Tableware crockery
Production capacity	5–6.0 MT /day
Date of energy audit	June 2006
Kiln details	
Kiln type	Tunnel Kiln (150' long) six burners, Wesmann make
Insulation	Ceramic fibre
Fuel used	C-9; landed cost Rs 26.5 /lit re
Specific fuel consumption	0.14 litre/kg of the product
Cost of C9 for kiln	Rs 5.460 million per year
Electrical and standby power consumption	
Electrical load	70 kW
Electricity consumption	7000 kWh/month
Per unit price of electricity	Rs 4.10 /kWh
Cost of electricity from SEB	Rs 0.344 million/year
Standby DG sets	60 KVA
HSD consumption	100 litre /day
Cost of HSD for DG Sets	Rs 1.05 million/year
Energy conservation measures already initiated by the firm	
➢ Temperature monitoring at eight zones in the kiln. ➢ Use of branded kiln furniture and cordite sagger plates. ➢ Capacitors for power factor control.	
Key observations and recommendations	
Raw material preparation and greening stage The quality checks during the process stages—from raw material to firing—are all done visually. Presently, there is no data on moisture content of the clay being purchased. The raw material (clay) should be tested, and only clay with moisture content of 2% may be accepted. The clay should conform to the specifications of IS 2400-1965 and Feldspar as per IS: 9749-1981. The ratio of charge: grinding media: water should be 1:1.1:0.6.	
Firing: kiln technology and efficiency The unit is using tunnel kiln with a daily fuel consumption of 700 litres of C-9. The oxygen content in the exhaust is high at 19%, which has to be reduced to 10% (details given in the energy audit report). The exhaust temperature has to be maintained at about 200–210 oC (220 oC measured in audit) using a thermocouple sensor with temperature indicator, and adjusting the chimney damper and/or burner damper. It is recommended to provide	

manometer pockets along the length of the kiln for pressure measurements to maintain the required pressure profile by adjusting the damper. The details are given in the energy audit report.

Efficiency of the burner efficiency can be improved by using low excess air burners, and providing a simple automatic control to switch off the burners at the set point temperature. The kiln has a common blower to supply air to the burners and for the cooling zone of the kiln. Separate blowers can be provided for combustion and for the cooling zone. Waste heat recovery from the chimney exhaust can be used for drying the green product. The unit can use advanced nitride bonded silicon carbide material for kiln furniture to improve the ratio of product mass to kiln furniture.

Energy savings: kiln

S. No.	EEM	Savings in fuel (kl/year)	Value of savings (Rs/Annum)	Investment (Rs)
1.	Reduce excess air in present operation	10.5	278 000	110 000
2.	Improvements to combustion system (blower, burner, and automation)	31.5	835 000	800 000
3.	Lightweight kiln furniture	4.44	1 18 000	250 000
	Total	46.44	1 231 000	1 160 000

The unit can opt for natural gas as fuel for the kiln (when NG pipeline infrastructure becomes available), which will save Rs 1.789 million with an investment of Rs 1 million for piping and burners

Energy Savings : electrical energy and stand by power

Power supply from the SEB is very limited (8–10 hours per day). So, the unit depends on backup DG sets. The unit uses a locally-made 60 KVA reconditioned DG set. It is recommended to install a voltage stabilizer and maintain voltage at 415 V for the grid power to improve performance of motors and reduce burnouts

S. No.	EEM	Savings in fuel (kl/year)	Value of savings (Rs/Annum)	Investment (Rs)
1.	Voltage control in electrical system	Not quantified		
2.	Use of biomass gasifier and gas engine to replace DG set		640 000	1 800 000

* Details of the calculations are given in the Annexure to the energy audit report

Benchmark and Target fuel Consumption

Particulars	Present	Target
Specific energy generation – kWh/l	Not monitored, expected to be about 1.5	2.2

Specific fuel consumption: kiln (l/kg)	0.14	0.11
Implementation Approach		
During discussions with the unit management, the following areas of support were requested. ❖ Convince the management on importance of scientific benchmarking ❖ Discuss and detail the equipment layout and changes ❖ Identification of proper suppliers of equipment		

Silico and Chemico Porcelain Works: Energy Audit Highlights	
Location	Khurja, Uttar Pradesh
Year of commencement	1960
Product	Laboratory ware
Production capacity	12 MT/month
Date of energy audit	June 2006
Kiln Details	
Kiln type	Shuttle Kiln , four burners, Wesmann make
Insulation	Ceramic fibre
Fuel used	HSD; landed cost Rs 35 /litre
Specific fuel consumption	0.27 litre/kg of the product
Cost of HSD for kiln	Rs 1.68 million per year
Electrical and standby power consumption	
Electrical load	20 kW
Electricity consumption	1400 kWh/month
Per unit price of electricity	Rs 4.10/kWh
Cost of electricity from SEB	Rs 0.07 million per year
Standby DG sets	60 KVA
HSD consumption	600 l/month
Cost of HSD for DG sets	Rs 0.25 million per year
Energy conservation measures already initiated by the firm	
➢ Capacitors for power factor control ➢ Replaced downdraft coal-fired kiln to oil-fired shuttle kiln	
Key observations and recommendations	
Raw material preparation and greening stage Quality checks during the various processing stages—from raw material to firing—are mainly done visually. Presently, there is no data on moisture content of the clay being purchased. It is recommended to test the raw material (clay) and only accept the clay with moisture content of 2% (testing method is given in the detailed energy audit report for the unit). The clay should conform to the specifications of IS 2400-965 and Feldspar as per IS: 9749-1981. The ratio of charge: grinding media: water should be 1:1.1:0.6	

Firing: kiln technology and efficiency

The unit is using shuttle kiln with a fuel consumption of 400 l/batch. The excess air levels based on airflow measurements of the blower and correlation with oil flow is estimated to be 40% (that is, 8% O_2) during firing cycle. A damper and a thermocouple with temperature indicator to be provided at the chimney to control the draft to reduce excess air to 30% (that is, 5% O_2).

- Efficiency of the burner can be improved by using low excess air burners, and providing a simple automatic control to switch off the burners at the set point temperature.
- Waste heat recovery from the chimney exhaust can be used for preheating combustion air. This option is better than using the waste heat for drying, because the temperatures will vary during the batch process.
- The unit can use advanced nitride bonded silicon carbide material for kiln furniture.
- The economics and savings of the recommendations pertaining to the kiln are given below.

Energy savings: kiln

S. No.	EEM	Savings in fuel (kl/year)	Value of savings (Rs/Annum)	Investment (Rs)
1.	Reduce excess air in present operation	5	175 000	Negligible
2.	Improvements in combustion system (blower and burner)	7.2	252 000	470 000
3.	Waste heat recovery for preheating combustion air	12	4 20 000	600 000
	Total	24.2	847 000	10,70,000

The unit can opt for natural gas as a fuel for the kiln (when NG pipeline infrastructure becomes available), which will save Rs 0.504 million with an investment of Rs 1 million for piping and burners.

Energy savings: electrical energy and standby power

Power supply from the SEB is very limited (8–10 hours per day). So, the unit depends on backup DG sets. The unit uses a locally-made 60 KVA reconditioned DG set. It is recommended to install a voltage stabilizer and maintain voltage at 415 V.

S. No	EEM	Savings in fuel	Savings (Rs/Yr)	Investment (Rs)
1.	Voltage control in electrical system	Not quantified		

Benchmarks and target fuel consumption

Particulars	Present	Target
Specific fuel consumption: kiln (l/kg)	0.26	0.20
Specific energy generation: kWh/litre	Not monitored, expected to be about 1.5	2.2

Implementation approach

Based on the discussions with the unit's management, it was found that there is a need to work with them for implementing the EEMs as they lack the capacity to do it themselves.

Following is the support required by them.

- Help the unit monitor and benchmark energy
- Assist them in implementation of EEMs
- Detailed engineering for recommendations (where required, for example, with waste heat recovery system) taking into consideration layout and operational constraints
- Assistance in identification and selection of vendors, and oversee proper implementation
- Post-implementation measurement and verification of savings and means to sustain the savings

Vineet Decorators: Energy Audit Highlights	
Location	Khurja, Uttar Pradesh
Year of commencement	2000
Product	Tableware/ stoneware
Production capacity	170 MT/month
Date of energy audit	June 2006
Kiln details	
Kiln type	Tunnel Kiln (108' long) four burners, Wesmann make
Insulation	Ceramic fibre, HF8
Fuel used	HSD; landed cost Rs 35 /litre
Specific fuel consumption	0.14 litre/kg of the product
Cost of HSD for kiln	Rs 8.19 million per year
Electrical and standby power consumption	
Electrical load	30 kW
Electricity consumption	4000 kWh/month
Per unit price of electricity	Rs 4.10 /kWh
Cost of electricity from SEB	Rs 0.196 million per year
Standby DG sets	35 KVA
HSD consumption	80 litres/day
Cost of HSD for DG sets	Rs 0.84 million per year
Energy conservation measures already initiated by the firm	
➢ Temperature monitoring at four zones in the kiln. ➢ Capacitors for power factor control.	
Key observations and recommendations	
Raw material preparation and greening stage Quality control checks performed from raw material to firing stage are mainly based on visual inspection. Presently, there is no data on moisture content of the clay being purchased. The unit should test the raw material (clay), and select clay with moisture content of 2% (testing method is given in the detailed energy audit report for the unit). The clay should conform to the specifications of IS 2400-1965 and Feldspar as per IS:	

9749-1981. It is recommended to maintain a ratio of charge: grinding media: water of 1: 1.1: 0.6 for ball mills.

Firing: kiln technology and efficiency

The daily fuel consumption of the tunnel kiln is 700 litres of HSD. The oxygen content in the exhaust is observed to be 16%, which has to be reduced to 10% by monitoring the same through a flue gas analyzer, and adjusting the damper to be provided at the chimney base. The exhaust temperature should be maintained at around 200–210 °C (282 °C measured in audit) using a thermocouple sensor with temperature indicator, and adjusting the chimney damper and /or burner damper. It is recommended to provide manometer pockets along the length of the kiln for pressure measurements to maintain the required pressure profile through adjustment of the damper. The details are provided in the energy audit report.

Efficiency of the burner can be improved by using low excess air burners with automatic control to switch off the burners at set point temperature. It is recommended to provide separate blowers for combustion air and for the cooling zone of the kiln. The waste heat recovery from the chimney exhaust can be used for drying the green product prior to firing in the kiln. The unit can use advanced nitride bonded silicon carbide material for kiln furniture to improve the ratio of product mass to kiln furniture. The energy savings out of the recommendations pertaining to the kiln are given below.

Recommendations and savings: kiln

S.No.	EEM	Savings in fuel (kL/year)	Value of savings (Rs/Annum)	Investment (Rs)
1.	Reduce excess air in present operation	5	175 000	1.10 000
2.	Improvements to combustion system (blower, burner, and automation)	35.1	1228 000	800 000
3.	Lightweight kiln furniture	8.77	306 000	225 000
	Total	48.87	1 709 000	1 136 000

The unit can opt for natural gas as a fuel for the kiln (when NG pipeline infrastructure becomes available), which will save Rs 2.457 million with an investment of Rs 1 million for piping and burners.

Electrical energy and standby power

Power supply from the SEB is for 8–10 hours per day. The unit uses a locally-made 35 KVA reconditioned DG set. It is recommended to monitor power generation from the DG set by providing an energy meter (an investment of Rs 1000). This will facilitate monitoring specific energy generation of the DG set.

S. No	EEM	Savings in fuel	Savings (Rs/Yr)*	Investment (Rs)
1.	Use of biomass engine to replace HSD		378 000	1 800 000

* Details of the calculations are given in the Annexure to the energy audit report.

Benchmarks and target fuel consumption

Particulars	Present	Target
Specific fuel consumption: kiln (lts/kg)	0.14	0.11

Specific energy generation: kWh/L	Not monitored, expected to be about 1.5	2.2

Implementation approach

Based on the study of the unit, and after discussions with the unit's management, it is realized that there is a need to assist them in implementing the EEMs, because they are unable to undertake these on their own. Following are the areas in which they need support.

- Detail engineering of recommendations for proper implementation
- Assistance in vendor identification and selection, and overseeing proper implementation
- Savings verification after implementation

Morbi cluster

Face Ceramics: Energy Audit Highlights	
Location	Morbi, Gujarat
Year of commencement	2000
Product	Wall tiles
Production capacity	36000 MT/year
Date of energy audit	July 2006
Kiln details	
Kiln type	Three roller kilns (110m-long, biscuit firing; 87m and 54m long kilns). Two made in Italy and one locally made
Insulation	Refractory
Fuel used	Producer gas (coal); landed cost of coal - Rs 5500 /MT
Specific fuel consumption	0.162 kg of coal/kg of product
Cost of coal for kilns	Rs 30.387 million per year
Electrical and standby power consumption	
Electrical load	825 kW
Electricity consumption	300 000 kWh/month
Per unit price of electricity	Rs 4.85 /kWh
Cost of electricity from SEB	Rs 17.460 million per year
Specific electricity consumption	0.102 kWh/kg
Standby DG sets	400 KVA (2 nos.) and 500 KVA (2 nos.)
HSD consumption	Only for emergency purposes
Cost of HSD for DG sets	Negligible

Energy conservation measures already initiated by the firm

- Use of producer gas using coal as feed stock
- Waste-heat recovery from kilns for dryers
- Use of *putri* (groundnut shell) as fuel for spray dryer

Key observations and recommendations

Raw material preparation and greening stage

The unit monitors quality of the raw materials. The unit's quality management system is ISO-9002 certified, and has all quality control checks in place. Water addition to ball mills should be monitored and controlled at 16%. It is recommended to benchmark energy (kWh/MT) of grinding for different mixes for ball mills.

Firing: kiln technology and efficiency

The unit is using three roller kilns and two dryers with a daily coal consumption of 17 MT. The oxygen content in the exhaust is high (16%–18%) in the exhaust blowers of the pre-heating zone, which has to be reduced to 9%–10% by monitoring the same through a flue gas analyser, and adjusting the damper at the chimney base. The exhaust temperature has to be maintained at about 200–210 ^{o}C. The insulation is damaged in some portions (near the burner) of the firing zone. This needs to be corrected.

Details of savings for the EEMs pertaining to the kiln are given below.

Recommendations and savings: kiln

S.	EEM	Savings in coal	Savings value	Investment

No.		(MT/year)	(Rs/Annum)	(Rs)
1.	Optimize excess air in present operation by using an advanced flue gas analyser that monitors O_2 levels in the exhaust and automatically controls the damper	270	1 485 000	660 000 (Rs 220 000 for each kiln x 3 nos.)
2.	Correct insulation in firing zone	Not quantified		Routine maintenance
	Total savings / Investment	270	1 485 000	660 000

Electrical energy and standby power

The electricity supply is from Paschim Gujarat Vij Company Ltd (PGVC) through an 11 kV HT connection. This is stepped down to 433 V before the power is distributed. The monthly electricity consumption is 300 000 kWh. The unit has two 500 kVA and two 400 kVA DG sets. Given that the power supply from PGVC is reliable, the DG set is used purely for emergency purposes.

Electrical energy consumption: recommendations

The recorded demand exceeds the contracted maximum demand. It is recommended to monitor demand and implement demand-side management measures to avoid penalties.

Since the power factor is leading in the incomer panel, *it is recommended to check and correct the same.*

It is also suggested to correct the overload of fast cooling of Kiln 3 and chimney blower of Kiln 1. It is observed that the blower damper of the combustion, exhaust, and rapid-cooling blowers are partially open (40%–60%). The combustion blower airflow depends on the producer gas flow. It is, therefore, recommended to provide variable frequency drives for the combustion and cooling blowers.

Following are the EEMs for the electrical systems.

S. No.	EEM	Savings in Electricity (kWh/Annum)	Savings (Rs/Yr)*	Investment (Rs)
1.	Control of demand	Not quantified		
2.	Maintain power factor 0.98 lag	Not quantified		80 000
3.	Correct overload of fast cooling of kiln3 and chimney blower of kiln 1	Not quantified		
4.	Use ef VFDs for combustion and exhaust blowers	259 000	1 255 000	1 690 000
	Total	259 000	1 255 000	1 770 000

* Details of the calculations are given in the Annexure to the energy audit report.

Benchmarks and target fuel consumption

Particulars	Present	Target
Specific coal consumption: kiln (kg/kg)	0.162	0.15
Specific electricity consumption: (kWh/kg)	0.103	0.095

The unit does not require much support in implementation but could use assistance in matters related to the following.

- Monitor and benchmark energy systematically
- Post-implementation measurement and verification of energy savings
- Detailed engineering of the measures to sustain the savings

Galaxy Sanitary Ware: Energy Audit Highlights	
Location	Morbi, Gujarat
Year of commencement	1992
Product	Sanitary ware
Production capacity	5–6.5 MT/day
Date of energy audit	July 2006
Kiln details	
Kiln type	Tunnel kiln: 54m long
Insulation	Ceramic fibre
Fuel used	Mixed oil; landed cost of mixed oil - Rs 23/litre
Specific fuel consumption	0.13 litre/kg of product
Cost of mixed oil for kilns	Rs 5.865 million per year
Electrical and standby power consumption	
Electrical load	100 kW
Electricity consumption	19 000 kWh/month
Per unit price of electricity	Rs 4.85 /kWh
Cost of electricity from SEB	Rs 1.116 million per year
Specific electricity consumption	0.152 kWh/kg
Standby DG sets	63.5 kVA (1 no.)
HSD consumption	Only for emergency purposes
Cost of HSD for DG Sets	Negligible
Energy conservation measures already initiated by the firm	
• None so far	
Key observations and recommendations	
Raw material preparation and greening stage It is recommended to monitor the moisture in ball clay that is purchased from outside. The moisture percentage can vary. The acceptable moisture content should be about 2%. It is recommended to monitor water addition in ball mills. It should be about 16% of the total weight. The moisture content of the slip is 16%–17%.	
Firing: kiln technology and efficiency The unit is using tunnel kiln with a daily mixed oil consumption of 700–850 litres. It is recommended to monitor the oxygen content in the exhaust blowers of the pre-heating zone and maintain the same at 9%–10%, by using a flue gas analyser and adjusting the damper at the chimney base. The exhaust temperature has to be maintained at about 200–210 ^{o}C. It is noted that the preheating zone thermocouples are not working. It is recommended	

to repair the same.

It is recommended to use low excess air burners for better fuel economy. It is recommended to recover the waste heat from kiln and use it for drying the greens.

The savings for the EEMs pertaining to the kiln are given below.

Recommendations and savings: kiln

Sl No.	EEM	Savings in Mixed Oil (kL/year)	Savings Value (Rs/Annum)	Investment (Rs)
1.	Repair and monitor preheating zone thermocouples	Not quantified		
2.	Reduce excess air in present operation	12	276 000	110 000
3.	Improvements to combustion system (low excess air burners and automation)	25.50	587 000	1 100 000
4.	Heat recovery for drying	15	345 000	500 000
	Total savings / Investment	52.5	1 208 000	1 710 000

Electrical energy and standby power

The electricity supply is from the PGVC through an LT connection. The monthly electricity consumption is 19 000 kWh. The unit has one 63.5 kVA DG sets. Power supply from PGVC being reliable, the DG set is used purely for emergency purposes.

Electrical energy consumptio: recommendations

The power factor in the incomer is low (0.67). It is recommended to provide 15 kVAR capacitors.

It is noted that the blower damper of the combustion and cooling blowers are partially open .The combustion blower airflow depends on the oil flow. It is, therefore, recommended to provide variable frequency drives for combustion and exhaust air blowers.

Following are the EEMs for the electrical systems.

Sl No	EEM	Savings in kWh /yr	Savings (Rs/Yr)*	Investment (Rs)
1.	Provide 15 kVAR capacitors and maintain power factor above 0.90		Savings are low and, hence, not quantified	
2.	Use of VFDs for combustion blowers	12 000	60 000	70 000

The benchmarks and target fuel consumption

Particulars	Present	Target
Specific fuel consumption: kiln (litre/kg)	0.13	0.11
Specific electricity consumption (kWh/kg)	0.152	0.145

There is a need to work with the unit for implementing the EEMs. Following are the support required by them.

- Work with them to monitor and benchmark energy

- Assistance in vendor identification and selection and supervise the implementation
- Post-implementation measurement and verification of energy savings

Sonex Ceramics: Energy Audit Highlights	
Location	Morbi, Gujarat
Year of commencement	1994
Product	Sanitary ware
Production capacity	2746 MT/annum
Date of energy audit	July 2006
Kiln details	
Kiln type	Tunnel kiln: 52m long
Insulation	Ceramic fibre
Fuel used	C-9; landed cost Rs 28/litre
Specific fuel consumption	0.13 litre/kg of product
Cost of C-9 for kilns	Rs 11.2 million per year
Electrical and standby power consumption	
Electrical load	120 kW
Electricity consumption	38 000 kWh/month
Per unit price of electricity	Rs 4.85 /kWh
Cost of electricity from SEB	Rs 2.188 million per year
Specific electricity consumption	0.141 kWh/kg
Standby DG sets	125 kVA (1 no.)
HSD consumption	Only for emergency purposes
Cost of HSD for DG Sets	Negligible
Energy conservation measures already initiated by the firm	
• Introduced waste-heat recovery system to recover heat from kiln. The same is not operational due to mechanical problems. • Use of branded (CUMI) kiln furniture • Temperature measurements at 15 zones in the kiln.	
Key observations and recommendations	
Raw material preparation and greening stage It is recommended to monitor the moisture in ball clay that is purchased from outside. The moisture percentage can vary. The acceptable moisture content should be about 2%. It is recommended to monitor water addition in ball mills to ensure that the proportion is around 16% of the total weight. The moisture content of the slip is 16%–17%. It is recommended to monitor the material balance from the raw material to the greens	

stage. It is recommended to use singular blended clay developed by CGCRI.

Firing: kiln technology and efficiency

The unit is using tunnel kiln with a daily C-9 consumption of 1200 litres. The oxygen content in the exhaust is high at 18% in the exhaust blowers of the pre-heating zone, which has to be reduced to 9%–10% by monitoring the same through a flue gas analyser, and adjusting the damper at the chimney base. The exhaust temperature has to be maintained at about 200–210 ^{o}C.

It is recommended to use low excess air burners for better fuel economy. The savings for EEMs pertaining to the kiln are given below.

Recommendations and savings: kiln

S. No.	EEM	Savings in C-9 (kL/year)	Savings value (Rs/Annum)	Investment (Rs)
1.	Reduce excess air in present operation	20	550 000	110 000
2.	Improvements to combustion system (low excess air burners and automation)	40	1 120 000	1 100 000
3.	Improvements to heat recovery for drying	15.6	438 000	500 000
	Total savings / Investmens	75.6	2 118 000	1 710 000

Electrical energy and standby power

The electricity supply is from the PGVC through an 11 kV HT connection. This is stepped down to 433 V before the power is distributed. The monthly electricity consumption is 38 000 kWh. The unit has one 125 kVA DG set. The power supply from the PGVC being reliable, the DG set is used purely for emergency purposes.

Electrical energy consumption: recommendations

The power factor in the incomer is low (0.78). As sufficient capacitors have been provided, it is recommended to regularly check the capacitors and replace any damaged ones.

It is observed that the dampers of the combustion and cooling blowers are partially open (40%–60%). The combustion blower airflow depends on the oil flow. It is, therefore, recommended to provide variable frequency drives for combustion and exhaust air blowers.

The motor loading of the ball mills varies between 40% and 66%, depending on the slurry condition. It is recommended to provide Delstar converters to take care of lightly loaded motors. The motor will change from delta to star depending on the motor load.

Following are the EEMs for the electrical systems.

S. No.	EEM	Savings in electricity (kWh /annum)	Savings (Rs/Yr)*	Investment (Rs)
1.	Check capacitors and maintain power factor		23 000	
2.	Use of VFDs for blowers	24 000	117 000	160 000
3.	Delstar energy savers for ball mills	27 000	131 000	75 000

	Total	51 000	271 000	235 000

The benchmarks and target fuel consumption		
Particulars	**Present**	**Target**
Specific fuel consumption: kiln (litres/kg)	0.14	0.11
Specific electricity consumption (kWh/kg)	0.141	0.13

The unit may require assistance for implementing the EEMs. The following support is required by them.

- Work with them to monitor and benchmark energy
- Assistance in vendor identification and selection
- Oversee proper implementation
- Post-implementation measurement and verification of the energy savings
- Detailed engineering for the EEMs to sustain the savings

Metro Ceramics: Energy Audit Highlights	
Location	Morbi, Gujarat
Year of commencement	2003
Product	Wall tiles
Production capacity	48 MT/day
Date of energy audit	July 2006
Kiln details	
Kiln type	Roller kiln: 70m long
Insulation	Refractory
Fuel used	Producer gas (coal); landed cost of coal - Rs 6000 /MT
Specific fuel consumption	0.13 kg of coal/kg of product
Cost of coal for kilns	Rs 10.725 million per year
Electrical and standby power consumption	
Electrical load	300 kW
Electricity consumption	100 000 kWh/month
Per unit price of electricity	Rs 4.85 /kWh
Cost of electricity from SEB	Rs 5.796 million per year
Specific electricity consumption	0.102 kWh/kg
Standby DG sets	400 KVA (1 no.) and 250 KVA (1 no.)
HSD consumption	Only for emergency purposes
Cost of HSD for DG sets	Negligible
Energy conservation measures already initiated by the firm	
• Use of producer gas (coal based) for the kiln • Waste heat used for combustion air and drying of greens	
Key observations and recommendations	

Raw material preparation and greening stage

It is recommended to monitor the moisture in ball clay that is purchased from outside. The moisture percentage can vary. The acceptable moisture content should be about 2%. It is recommended to monitor water addition in ball mills. It should be about 16% of the total weight. The moisture content of the slip is 16%–17%.

Firing: kiln technology and efficiency

The unit is using one roller kiln and a dryer with a daily coal consumption of 6.5 MT. The oxygen content in the exhaust is high at 18% in the exhaust blowers of the pre-heating zone, which has to be reduced to 9%–10% by monitoring the same through a flue gas analyser and adjusting the damper at the chimney base. The exhaust temperature has to be maintained at about 200–210 ^{o}C. The insulation is damaged in some portions (near the burner) of the firing zone. This needs to be corrected.

The savings for the EEMs pertaining to the kiln are given below.

Recommendations and savings: kiln

S. No.	EEM	Savings in coal (MT/year)	Savings value (Rs/Annum)	Investment (Rs)
1.	Reduce excess air in present operation	90	495 000	250 000
2.	Correct insulation in firing zone	30	165 000	Routine maintenance
	Total savings/Investment	120	660 000	250 000

Electrical energy and standby power

The electricity supply is from PGVC through an 11 kV HT connection. This is stepped down to 433 V before the power is distributed. The monthly electricity consumption is 100 000 kWh. The unit has one 400 kVA and one 250 kVA DG set. The power supply from PGVC being reliable, the DG set is used purely for emergency purposes.

Electrical energy consumption: recommendations

The combustion blower, rapid cooling blower, and feed pump are overloaded. It is recommended to correct the same, by checking the mechanical alignment, bearings, and windings.

It is noted that the blower damper of the combustion, exhaust, and rapid cooling blowers are partially open (40%–60%). The combustion blower airflow depends on the producer gas flow. It is, therefore, recommended to provide variable frequency drives (VFDs) for combustion and exhaust air blowers.

The motor loading of the ball mills varies between 40% and 66%, depending on the slurry condition. It is recommended to provide Delstar converters to take care of lightly loaded motors. The motor will change from delta to star depending on the motor load.

Following are the EEMs for the electrical systems.

S. No.	EEM	Savings (kWh/yr)	Savings (Rs/Yr)*	Investment (Rs)
1.	Correct overload of combustion blower, rapid cooling blower, and feed pump	Not quantified		
2.	Use of VFDs for combustion and exhaust blowers	63 000	305 000	290 000

3.	Delstar energy savers for ball mills	25 000	121 000	30 000
	Total savings/ Investment	88 000	426 000	320 000

The benchmarks and target fuel consumption		
Particulars	**Present**	**Target**
Specific fuel consumption: kiln (kg/kg)	0.13	0.11
Specific electricity consumption (kWh/kg)	0.08	0.075

Implementation approach

Following may be the support required by the unit for implementation of the recommended EEMs.

- Assistance to monitor and benchmark energy
- Work with them to detail the recommendations and selection of EEMs
- Detailed engineering of the recommendations (where required, for example, use of waste heat for spray dryer) taking into consideration layout and operational constraints
- Assistance in vendor identification and selection, and supervise the implementation
- Post-implementation measurement and verification of energy savings, and sustain the same

Thangadh cluster

Royal Ceramic: Energy Audit Highlights	
Location	Thangadh, Gujarat
Year of Commencement	2000
Product	Insulators
Production capacity	45 MT/month
Date of energy audit	July 2006
Kiln details	
Kiln type	Tunnel kiln: 30m long
Insulation	Ceramic fibre
Fuel used	Mixed oil; landed cost of mixed oil - Rs 23/litre
Specific fuel consumption	0.13 litre/kg of product
Cost of mixed oil for kilns	Rs 2.3 million per year
Electrical and standby power consumption	
Electrical load	26 kW
Electricity consumption	3100 kWh/month
Per unit price of electricity	Rs 4.85/kWh
Cost of electricity from SEB	Rs o.18 million per year
Specific electricity consumption	Not evaluated. A small unit, and hence, no major recommendation on electrical matters
Standby DG sets	15 kVA (1 no.)
HSD consumption	Only for emergency purposes
Cost of HSD for DG Sets	Negligible
Energy conservation measures already initiated by the firm	
None so far	
Key observations and recommendations	
Raw material preparation and greening stage It is recommended to monitor the moisture in ball clay that is purchased from outside. The moisture percentage can vary. The acceptable moisture content should be about 2%. It is recommended to monitor water addition in ball mills. It should be about 16% of the total weight. The moisture content of the slip is 16%–17%.	
Firing: kiln technology and efficiency The unit is using tunnel kiln with a daily mixed oil consumption of 300–350 litres. It is recommended to monitor the oxygen content in the exhaust blowers of the pre-heating zone to 9%–10% by monitoring the same through a flue gas analyser and adjusting the damper at the chimney base. The exhaust temperature has to be maintained at about 200–210 ^{o}C. The unit has a common blower for cooling and combustion air supply. It is recommended to provide separate blowers. It is also recommended to use low excess air burners for better fuel economy. The savings for the EEMs pertaining to the kiln are given below.	

Recommendations and savings: kiln				
S. No.	**EEM**	**Savings in mixed oil (kL/year)**	**Savings value (Rs/Annum)**	**Investment (Rs)**
1.0	Fine-tuning measures and reduced excess air	10	230 000	110 000
2.0	Use of low excess air burner and blower	15	397 000	570 000
	Total savings/Investment	25	627 000	680 000

Electrical energy and standby power
The electricity supply is from the PGVC through an LT connection. The monthly electricity consumption is 3100 kWh. The unit has one 15 kVA DG set. The power supply from PGVC being reliable, the DG set is used purely for emergency purposes.
Electrical energy consumption: recommendations
None, as the electrical energy consumption is too small.
The benchmarks and target fuel consumption

Particulars	**Present**	**Target**
Specific fuel consumption: kiln (litre/kg)	0.13	0.11

Implementation approach
The following is the support that may be required by the unit for implementation of the EEMs. ▪ Work with them to monitor and benchmark energy ▪ Assistance in vendor identification and selection ▪ Oversee proper implementation ▪ Post-implementation measurement and verification of energy savings

Ariston Ceramics: Energy Audit Highlights	
Location	Thangadh, Gujarat
Year of commencement	2003
Product	Sanitary ware
Production capacity	8640 MT/annum
Date of energy audit	July 2006
Kiln details	
Kiln type	Tunnel Kiln: 114m long
Insulation	Ceramic fibre
Fuel used	C-9; landed cost Rs 31/litre
Specific fuel consumption	0.1litre/kg of product
Cost of C-9 for kilns	Rs 26.598 million per year
Electrical and standby power consumption	
Electrical load	-
Electricity Consumption	2,200 kWh/month (only for kiln, as rest are under different name)

Per unit price of electricity	Rs 4.85/kWh
Cost of electricity from SEB	Rs 0.128 million per year
Specific electricity consumption	Not evaluated
Standby DG sets	Common for other companies
HSD consumption	Only for emergency purposes
Cost of HSD for DG sets	Negligible

Energy conservation measures already initiated by the firm

- Timer-based alarm system for kiln car movement
- Use of branded (CUMI) kiln furniture
- Temperature measurements at seven zones in the kiln

Key observations and recommendations

The unit is using tunnel kiln with a daily C-9 consumption of 2600 litres. The oxygen content in the exhaust is high at 16.65% in the exhaust blowers of the pre-heating zone, which has to be reduced to 9%–10%, by monitoring the same through a flue gas analyser and adjusting the damper at the chimney base. The exhaust temperature has to be maintained at about 200–210 ^{o}C.

It is recommended to use low excess air burners for better fuel economy. It is also recommended to recover the waste heat from the kiln and use it for hot combustion air and drying the greens.

The savings for the EEMs pertaining to the kiln are given below.

Recommendations and savings: kiln

S. No.	EEM	Savings in C-9 (kL/year)	Savings value (Rs/Annum)	Investment (Rs)
1.	Reduce excess air in kiln operations	40	1 120 000	110 000
2.	Use of low excess air burners and automation	85	2 619 000	1 300 000
3.	Heat recovery for drying and combustion	13	400 000	650 000
	Total savings / Investment	138	4 139 000	2 060 000

Electrical energy and standby power

The electricity supply is from the PGVC through an LT connection. The monthly electricity consumption is 2200 kWh. This power is used only for kiln, as other equipments are under group company name. The DG sets are common for group companies.

Electrical energy consumption: recommendations

It is noted that the blower damper of the combustion and cooling blowers are partially open (40%–60%). The combustion blower airflow depends on the oil flow. It is, therefore, recommended to provide variable frequency drives for combustion and exhaust air blowers. Following are the EEMs for the electrical systems.

S. No	EEM	Savings (kWh /yr)	Savings (Rs/Yr)	Investment (Rs)
1.	Use of VFDs for blowers	8800	43 000	100 000

The benchmarks and target fuel consumption

Particulars	Present	Target

Specific fuel consumption: kiln (litre/kg)	0.11	0.105
Specific electricity consumption (kWh/kg)	0.141	0.13
Implementation approach		
The unit possesses the required technical skills to implement the recommended EEMs on its own.		

Sunrise Ceramics: Energy Audit Highlights	
Location	Thangadh, Gujarat
Year of commencement	1976
Product	Sanitary ware
Production capacity	1200 MT/month
Date of energy audit	July 2006
Kiln details	
Kiln type	Tunnel kiln: 72m long
Insulation	Ceramic fibre
Fuel used	Producer gas (coal); landed cost Rs 5500 per MT
Specific fuel consumption	0.3 litre/kg of product
Cost of coal for kilns	Rs 6.256 million per year
Electrical and standby power consumption	
Electrical load	90 kW
Electricity consumption	25 000 kWh/month
Per unit price of electricity	Rs 4.85/kWh
Cost of electricity from SEB	Rs 1.164 million per year
Specific electricity consumption	0.075 kWh/kg
Standby DG sets	250 kVA – (1 no.)
HSD consumption	Only for emergency purposes
Cost of HSD for DG sets	Negligible
Energy conservation measures already initiated by the firm	
• Audio-timer for kiln car movement. • Use of branded (CUMI) kiln furniture • Temperature measurements at six zones in the kiln	
Key observations and recommendations	
Raw material preparation and greening stage The unit monitors the essential quality parameters for raw materials. It is also required to monitor the material balance from raw material to finished product stage. This will identify wastage and reduce the same.	

Firing: kiln technology and efficiency

The unit is using tunnel kiln with a daily coal (producer gas) consumption of 3.5 to 4.0 MT/day. It is recommended to monitor the quality of producer gas. Oxygen content in the exhaust is high at 15.5% in the exhaust blowers of the pre-heating zone, which has to be reduced to 9%–10% by monitoring the same through a flue gas analyser and adjusting the damper at the chimney base. The exhaust temperature has to be maintained at around 200–210 ^{o}C.

It is recommended to recover the waste heat from kilns for preheating combustion air and for drying the greens.

The savings for the EEMs pertaining to the kiln are given below.

Recommendations and savings: kiln

S. No.	EEM	Savings in coal (MT/year)	Savings value (Rs/Annum)	Investment (Rs)
1.	Reduce excess air in kiln operations	56	308 000	110 000
2.	Heat recovery for drying and combustion	70	387 000	500 000
	Total savings / Investment	126	695 000	610 000

Electrical energy and standby power

The electricity supply is from the PGVC through an LT connection. The monthly electricity consumption is 25 000 kWh. The unit has one 250 kVA DG set. The power supply from PGVC being reliable, the DG set is used purely for emergency purposes.

Electrical energy consumption: recommendations

It is observed that the blower damper of the combustion and cooling blowers are partially open. The combustion blower airflow depends on the producer gas flow. It is, therefore, recommended to provide variable frequency drives for combustion and exhaust air blowers.

S. No.	EEM	Savings in electricity (kWh)	Savings (Rs/Yr)*	Investment (Rs)
1.	Use of VFDs for blowers	25 000	120 000	250 000

The benchmarks and target fuel consumption

Particulars	Present	Target
Specific fuel consumption: kiln (litre/kg)	0.31	0.26
Specific electricity consumption (kWh/kg)	0.075	0.070

Implementation approach

The unit may need assistance for implementing the EEMs. The following is the support that could be provided.

- Help them to monitor and benchmark energy
- Work with them to detail the recommendations and select the EEMs for implementation

Summary: Energy Audit Highlights

S. No.	Unit	Technology	Product	Production (Annual) MT	Energy Bill (Rs/ Million)			Quantity. of fuel (Annual)		Specific fuel consumption (SEC)		Investment for EA recommendations (Rs/Million)	Annual saving in Energy (Rs/Million)	Remarks
					Coal	Diesel	Electricity	Coal (MT)	Diesel (ltr)	Present	Target			
1	**Anupam Pottery**	DD kiln	Electric insulators	300	1.705	0.12	0.06	300	3500	1 kg/kg	0.7 kg/kg	2.16	0.565	EA
2	**Daya Ceramic**	Tunnel kiln	Crockery	1750		12.27	0.295		350 000	0.14 ltr/kg	0.11 ltr/kg	1.135	1.27	EA
												1.8	0.512	Biomass gasifier
												1.575	1.0	Fuel change option – CNG
3	**Gulati Ceramic**	Tunnel kiln	Bone china	1750		22.22	0.443		635 000	0.42 ltr/kg	0.35 ltr/ kg	1.725	4.189	EA
												1.8	o.614	Biomass gasifier
												0.8	0.588	Branded genset
												6.352	1.0	Fuel option – CNG
4	**Naresh Potteries**	Tunnel kiln	Electric insulators	2160		10.4	0.529		355 000	0.11 ltr /kg	0.105 ltr/kg	1.3	1.178	
												1.8	1.132	Biomass gasifier

												0.45	0.49	Branded genset
												1.789	1.0	Fuel option - CNG
5	**Pratap Ceramics**	Shuttle kiln	Art ware			5.46			156 000	0.58 ltr/kg				
6	**Shiv Potteries**	Tunnel kiln	Crockery	1800		6.51	0.344		156 000	0.14 ltr/kg	0.11 ltr/kg	1.16	1.231	EA
									30 000			0.18	0.614	Biomass gasifier
												1.789	1	Fuel option - CNG
7	**Silico and Chemico**	Shuttle kiln	Scientific instruments	144		1.932	0.07		48 000	0.27 ltr/kg	0.20 ltr/kg	1.07	0.847	EA
									7200			50.04	1	Fuel option - CNG
8	**Vineet Decorators**	Tunnel kiln	Table wares	2040		9.03	0.196		234 000	0.14 ltr/kg	0.11 ltr/kg	1.136	1.709	EA
									24 000			0.18	0.378	Biomass gasifier
												2.457	1	Fuel option - CNG
9	**Face Ceramics**	Roller kiln	Wall tiles	36 000	30.39		17.46	5525		0.162 kg coal/kg	0.15 kg coal/kg	0.66	1.485	EA
												1.69	1.255	Electrical EMM

10	**Galaxy Sanitary Ware**	Tunnel kiln	Sanitary wares	2000		5.865	1.116		255 000	0.13 ltr/kg	0.11 ltr/kg	1.72	1.208	EA
												0.07	0.06	Electrical EMM
11	**Metro Ceramic**	Roller kiln	Tiles	16 000	10.73		5.796	1800		0.13 kg coal/kg	0.11 kg/kg	0.25	0.66	EA
												0.32	0.426	Electrical EMM
12	**Sonex Sanitary**	Tunnel kiln	Sanitary wares	2746		11.2	2.188		400 000	0.13 ltr/kg	0.11 ltr/kg	1.71	2.12	EA
												0.235	o.271	Electrical EMM
13	**Ariston Ceramics**	Tunnel kiln	Sanitary wares	8640		26.6	**0.128**		858 000	0.10 ltr/kg,	0.105 ltr/kg	2.09	4.139	EA
												0.1	0.043	Electrical EMM
14	**Sunrise Potteries**	Tunnel kiln	Sanitary wares	1200	6.26		1.164	1140		0.3 ltr coal gas/kg		0.61	0.695	EA
												0.25	0.12	Electrical EMM
15	**Royal ceramics**	Tunnel kiln	Insulators	550		2.3	0.18		100 000	0.13 ltr/kg	0.11 ltr/Kg	0.68	0.627	EA
			Total	**77 080**	**49.1**	**113.9**	**30**	**8765**	**3 611 700**			**44.79**	**34.43**	

Broad outcomes of energy audits

On the basis of the unit-specific energy audits, it was estimated that the current annual energy consumption bill (Rs 192.9 million) of the selected units (15 nos. from three clusters) would reduce by Rs 42.9 million (savings) with an investment of Rs 36.9 million on implementation of the recommended measures. This implied that there was a potential of 20%–25% savings in the consumption of energy in the sector, as estimated in the project document.

Electric supply at Khurja is erratic and units have to necessarily incur heavy expenditure on operating diesel-operated generator sets. This has a huge negative impact on the cost-competitiveness of Khurja-based units.

Accordingly, energy audit recommends considering the option of biomass-based generators in place of diesel generators for the Khurja-based units.

Improving the process of firing, coupled with optimum drying of greens is another important recommendation towards energy conservation in units.

Use of natural gas in place of liquid fuels is strongly recommended from the point of view of energy efficiency and environmental impact. Despite some capital expenditure on remodeling the existing system of firing, the switch-over to natural gas is recommended for enhancing cost-competitiveness due to lower price of natural gas as compared to liquid fuels.

The energy audit recommends the use of equipments to monitor the process of firing, and initiate corrective measures based on proper analysis of the data to garner full benefits of the improved process of firing and enhance the quality of finished products.

4.3.3 Energy savings quantified for the three clusters

From the detailed energy audits of the 15 units at Khurja, Morbi, and Thangadh, it emerged that the current energy bill (Rs. 192.9 million) of the selective units would reduce by Rs. 42.9 million (savings) with an investment of Rs. 36.9 million on implementation of the recommended measures. This implied a potential of 20%–25% savings in the consumption of energy in the sector[11], thus corroborating with the estimates made in the project document.

4.3.4 Benchmarking of energy consumption and potential of energy savings

Through energy audits, the targets for specific fuel consumption (SFC) for each of the selective representative units was finalized considering the possible and feasible efforts on the part of the units to achieve the target (as mentioned in the energy audit highlights for each of the 15 units).

[11] **Source** Summary: Energy audit highlights and broad outcomes of energy audits

Benchmarking technology (cluster level)

Based on diagnostic studies, detailed energy audits of selective units, review of international literature, and discussions with national ceramic experts, the following technological benchmarks are proposed for ceramic manufacturing in the three clusters.

Khurja cluster

a) Kiln: oil-fired tunnel kiln with branded burners and burner blocks
b) Switch over to cleaner gas fuel as soon as it is made available
c) Burner and burner blocks to be upgraded on switch over of fuel from oil to gas
d) Kiln furniture: decker plates with cordierite refractory material
e) Raw material: IS specification for raw material (1S:2400-1965 for clay and 1S:9749-1981 feldspar)
f) Biomass-based DG sets to reduce dependence on diesel-operated gensets to meet electricity requirements
g) Optimum drying Greens: recommended to maintain 2% moisture before firing in the kiln
h) Using waste heat recovery system for drying greens
i) Handling: proper stacking of greens, properly designed crates and use of trolley
j) Packing: scientific packing for storage and handing during transportation

Morbi cluster

a. Tunnel kiln: natural-gas fired modern tunnel kiln with ceramic fibre insulation, branded burners and burner blocks, and timer indication for kiln car movement for sanitary ware
b. Roller kiln: natural gas fired, computer controlled roller kiln for ceramic tile units.
c. Biomass gasifier for spray dryer for tiles manufacturing units
d. Coal-based producer gas for biscuit firing tiles manufacturing units
e. Kiln furniture: decker plates with cordierite refractory material for sanitary ware units
f. Raw material: IS specification for raw material (IS 2400-1965 for clay and IS 9749-1981 feldspar) for sanitary ware and ceramic tile units
g. Greens: recommended to maintain 2% moisture in the greens before firing for sanitary ware, and 1%moisture in the greens for ceramic tiles
h. Dryer: scientifically designed dryer for sanitary ware using a separate room with hot air blowers and controlled humidity. For ceramic tiles, in addition to spray dryer, using agri-waste as fuel, and waste heat from the kiln to meet part of the heating requirement for spray drying

Thangadh cluster

a. Kilns
   i) Natural-gas fired modern tunnel kiln with ceramic fibre insulation, branded burners and burner blocks, and timer indication for kiln car movement for sanitary ware units
   ii) For some units that are contemplating to diversify into tile manufacturing, natural-gas fired, and computer-controlled branded roller kilns are recommended.
b. Use of producer gas to be restricted to biscuit-stage firing for ceramic tile units.
c. Kiln furniture: decker plates with cordierite refractory material for sanitary ware units
d. Raw material: IS specification for raw material (IS 2400-1965 for clay and IS 9749-1981 feldspar) for sanitary ware and ceramic tile units

e. Greens: recommended to maintain 2% moisture in the greens before firing for sanitary ware, 1% moisture in the greens for ceramic tiles, and 2% for other ceramic products
f. Dryer: scientifically designed dryer for sanitary ware using a separate room with hot air blowers and controlled humidity. For ceramic tiles spray dryer using agri-waste as fuel or waste heat from the kiln to meet part of the heating requirement for spray drying.

Manufacturing cost break-up (Khurja)[12]

Keeping in mind the information gap and reluctance of unit owners to share the manufacturing cost breakup, the following methodology was adopted to logically arrive at cost breakup for different product categories.

The product categories for which the manufacturing cost breakup has been calculated are insulators, stoneware, bone china, and art ware. Raw material cost was calculated based on production details provided by survey respondents on raw material required for production, process wastage, rejection, and the prevailing market cost of raw material, which goes into different categories. Similarly, based on fuel consumption provided by various units and cost of various fuels used, availability of grid power and usage of DG sets have been considered for calculating the fuel and power costs. Labour cost was calculated based on the number of skilled and non-skilled workers (data provided by individual units) assuming daily/monthly wages.

Table 4.1 Manufacturing cost breakup (Khurja)

Cost centre	Insulators	Stoneware	Bone china	Artware
Raw materials	33%	32%	30%	50%
Fuel and power	33%	31%	30%	30%
Labour	15%	14%	20%	10%
Others	19%	23%	20%	10%

Assumptions

(1) Prevailing raw material cost in Khurja: Ball clay: Rs 1000–1500 per MT (Avg: Rs 1200); Feldspar: Rs 1000–1200 per MT; Quartz: Rs 1000 per MT; China clay: Rs 2000 per MT (average)
(2) The price of various fuels in Khurja: Coal - Rs 5.5 per kg; HSD - Rs 35 per litre; C-9 – Rs 27 per litre, Mixed oil - Rs.23 per litre
(3) The estimated cost of production is assumed to be on an average Rs 15/kg for insulators, Rs 16/kg for stoneware, Rs 90/kg for bone china, and Rs 32/kg for artware.

[12] Diagnostic study report for Khurja Pottery and Ceramics Cluster, February 2007. (Prepared by Shri Shakti Alternative Energy Ltd Hyderabad, India)

Manufacturing cost breakup (Morbi)[13]

No proper data on manufacturing costs or break up is available with most of the units. Based on the data provided and the general industry averages, the percentage of manufacturing costs is depicted in the following table.

Table 4.2 Manufacturing cost breakup (Morbi)

Cost centre /Fuel used	Tiles /Producer gas	Tiles /Oil	Sanitary ware /Producer gas	Sanitary ware /Oil
Raw materials	42%	32%	38%	29%
Fuel and power	25%	31%	27%	31%
Labour	10%	14%	15%	20%
Others	23%	23%	20%	20%

Assumptions

1) Raw material costs are assumed as Ball clay: Rs 300–800 per MT (Avg: Rs 600); Feldspar: Rs 1000–1200 per MT; Quartz: Rs 1000 per MT; China clay: Rs 2000 per MT (average)
2) Fuel costs are assumed as Coal: Rs 5.5 per kg; C-9: Rs 28 per litre; and Mixed oil: Rs 23 per litre. The calorific values of the fuels are assumed to be coal: 4500kcal/kg; Mixed oil: 10 000 kcal/kg, and Sp.gr: 0.8; C-9: 10,500 kcal/kg, and Sp.gr: 0.8.

The raw material and energy costs account for a major portion of the manufacturing costs.

Manufacturing cost breakup (Thangadh)[14]

Table 4.3 Manufacturing cost breakup (Thangadh)

Cost centre /Fuel used	Sanitary ware /Producer gas	Sanitary ware /Oil
Raw materials	38%	29%
Fuel and power	27%	31%
Labour	15%	20%
Others	20%	20%

Assumptions

1) The raw material costs are assumed as - Ball clay: Rs 300–800 per MT (Average: Rs 600); Feldspar: Rs 1000–1200 per MT, Quartz: Rs 1000 per MT; China clay: Rs 2000 per MT (average)
2) The fuel costs are assumed as Coal (for producer gas): Rs.5.5 per kg; C-9: Rs 28 per litre; Mixed oil: Rs 23 per litre. The calorific values of the fuels are assumed as - Coal:

[13] Diagnostic study report for ceramics cluster at Morbi. (Prepared by Shri Shakti Alternative Energy Ltd Hyderabad, India)

[14] Diagnostic study report for ceramics cluster at Morbi. (Prepared by Shri Shakti Alternative Energy Ltd Hyderabad, India);

4500kcal/kg; Mixed oil: 10,000 kcal/kg and Sp.gr. 0.8; C-9: 10,500 kcal/kg and Sp.gr: 0.8.

The raw material and energy costs account for a major portion of the manufacturing costs.

4.3.5 Selecting representative units for demonstrating energy efficient technologies

An 'Interaction Meeting of Stakeholders' was organized in December 2005 at CGCRI, Khurja. At the meeting, the local industry associations and the units showed keen interest in participating in the programmes after the aims of the programme were explained the activities to be undertaken therein, and the expected results post completion of the programme. A lecture/talk on 'Energy-Efficiency measures in Tunnel Kilns - Possibilities' was also delivered by the PCRA during the meeting.

Two workshops were organized at each of the three clusters, namely, Morbi, Thangadh, and Khurja, in association with the local industry associations, to demonstrate and disseminate the effectiveness of the recommended EEMs to 100 ceramic SME units.

Following this, 50 units (38 from Khurja, and six each from Morbi and Thangadh) expressed their interest in participating in the programme, with an undertaking to bear part of the cost of implementation of activities. The units deposited 25% of the cost of diagnostic studies and energy audits as their contribution with the local associations. Incidentally, all costs related to the venue of the workshops, and all logistic and local transport costs during the workshop were borne by the units.

4.3.6 Implementation of energy audit recommendations

Based on the recommendations of the expert agencies, and suggestions received from the units in the three clusters during the diagnostic studies and energy audits, major areas of interventions for improving energy efficiency were identified, which included demonstration of energy-efficient technologies. The units were also assisted in implementation of energy audit recommendations.

4.3.6.1 Methodology adopted for implementation of EA recommendations

The methodology for implementing EA recommendations comprised of the following.

4.3.6.1.1 Appraisal of EA recommendations

As is standard practice, under the programme energy audit was carried out by employing energy auditors certified by the Bureau of Energy Efficiency (BEE). These auditors are specialists in the field of energy audit and management, and undertake audits of variety of industry sectors. To fine tune the recommendations in accordance with the requirement of the ceramic industry, the EA reports were appraised by ceramic scientists before the recommendations were presented to the selective units. During the appraisal process, factors specific to ceramic industry got duly factored in the EA recommendations. Mr A K Gupta, former scientist in-charge, CGCRI Khurja, who has a wealth of experience in working with the ceramic units, appraised the EA reports.

4.3.6.1.2 Detailed interactive sessions on ea recommendations with the units

The appraised reports were presented during separate interactive sessions with owners of selective units, and representatives of local industry associations and others at Khurja, Morbi, and Thangadh. Various aspects of EA recommendations were explained through practical demonstrations in the selective units. The interactive sessions were repeated until the owners of the units were convinced of the recommendations. Acknowledging their appreciation of EA recommendations, the owners of selective units paid their share (25%) of the cost of undertaking diagnostic study and energy audits.

4.3.6.1.3 Efforts in motivating unit owners for implementing the EEMs

Despite due appreciation of the positives of EA recommendations during the interactive sessions, the owners had to be motivated to implement the suggested measures for enhancing cost competitiveness of the units. To provide insight into the functioning of the units engaged in manufacturing similar products in competing nations, a visit to China was undertaken. This tour helped the owners of the selective units and representatives of the local industries to analyse and appreciate the factors leading to the competitive costs of Chinese ceramic products. With cost of energy and manpower being at par in India and China, the cost advantage is due to upgraded technologies, and efficient operation and processes. This has also led to sourcing of branded equipments and technology by the units to realize their expansion plans.

4.3.6.1.3.1 Training of managers and supervisors on EEMs

The small-scale ceramic units in all three clusters are family-owned. The management has limited role in operation and day-to-day maintenance of kilns and other equipments that account for major energy consumption in the units. Accordingly, it was decided to impress upon supervisors and operators the significance of EEMs in improving the quality of working environment as well as the quality of products. Tailor-made practical-oriented training programmes were held at the three clusters for the supervisors and operators.

Training on EEMs, Morbi

Training on EEMs, Thangadh

Training on EEMs, Morbi

Training on EEMs, Khurja

Training on EEMs, Khurja

4.3.6.1.3.2 International linkages

- In each of the 15 audited units, visits by China and UK-based consultants were organized for one-to-one discussions with the owners and managers, wherein the significance of appropriate technology/equipments was emphasized. The consultations were focused on impressing upon the fact that data collection and analysis are effective tools of energy efficiency. On the advice of the local industry associations, the experts from China and UK also visited some other units at the clusters. A presentation on improved tunnel kilns was prepared and shown to the unit owners, based upon recommendations of these international experts.
- Exposure-visit-cum-study-tours were organized for the owners and representatives of the local industry associations from the three clusters to the 21st International Ceramic Industry Exhibition at Guangzhou, China, and to the ceramic units at Foshan and Chouzhou.
- A visit was organized for five manufacturers from Morbi to the Coverings Fair at Orlando (USA) with the aim of providing selective ceramic units from the clusters, international exposure, and access to new markets. The fair is one of the most important exhibitions for tiles and stone slabs, and caters to the markets of USA, Central American countries, and the West Indies. The participating units displayed

their products in the international exhibition for the first time, thus getting the opportunity to explore an important market, and compare the cost and quality of their products with that of the competing nations.

Implementation of the recommendations of energy audits of selected ceramic units
The following EEMs were specifically introduced in different units.

1. Monitoring and maintaining the temperature and pressure profile of kiln
2. Use of low excess air burner with auto switch-off facility at set temperature point
3. Waste heat recovery system and switch over to CNG for cleaner and efficient firing at Morbi and Thangadh
4. Firing practices as per designed principles

The aforesaid approach of interactive sessions, exposure visit to energy-efficient units in China, and training and capacity- building of the key personnel, provided enough impetus to practise the suggested measures.

4.3.7 Preparation of film for documenting current status of the industry and barriers in improving the status

Two films were prepared under the project. The film, A documentary on 'Ceramic SMEs in India: Opportunities Ahead', produced by Credence Media Solutions (P) Ltd, was prepared during the middle of the project implementation stage. The film portrays the problems faced by the small-scale ceramic industry in India—obsolete and inefficient or second-hand imported technology, non-standard and inconsistent raw materials, high transportation costs, stiff competition by international players, and so on. Interviews with DIPP, UNIDO and CGCRI officials, along with the actual manufacturers, talk about the joint programme between UNIDO and the Indian government to employ energy-efficient technologies in select ceramic units in Uttar Pradesh and Gujarat, and also to improve the quality of their products and provide them with the right financing and marketing linkages. The film also showcases the efforts that were on to replace diesel and coal with cleaner fuels such as producer gas, liquefied natural gas, and even biomass.

The units have categorically mentioned the benefits from the activities taken up under the project up to the film-making stage. The film is highly useful and can be screened for the entrepreneurs of the ceramic SMEs to prove the effectiveness of interventions, and motivate them for large-scale adoption of the measures introduced under the programme.

Film II is a documentary portrayal of UNIDO's interventions made during September 2004–30 June 2010 in the three selected ceramic clusters of India, to improve the overall market competitiveness of the cluster units and mitigate GHG emissions by enhancing energy efficiency and overall productivity through standardization of raw materials, finished products, and so on.

4.3.8 Designing and hosting of website for hosting data and information on ceramic industry

A bilingual (Hindi and English) website providing information on the ceramic industry was designed as part of the project. The website <www.ceramics-smesindia.com>, hosted on the server of DIPP, Ministry of Commerce, Government of India, during the currency of the project, proved to be a repository of information for the manufacturers, exporters, and buyers of ceramic products in India. There were provisions to update the information from time to time. The technical section in the website comprised of the following information on technical matters mostly relevant to the small- and medium-scale manufacturers of ceramic products.

(a) National and international standards on raw materials
(b) National and international standards on finished products
(c) Testing procedures for raw material and finished products
(d) Standards and procedure for ISO certification

4.3.9 Training on EEMs

It was observed that the implementation of EEMs depends largely upon the operator/supervisor of the units. However, during the diagnostic studies and energy audits, it was seen that there is a general lack of awareness amongst technicians and other supervisory staff of the ceramic units about the factors resulting in energy loss, and about the techniques and controls to achieve energy efficiency in operations. It has also been realized that proper understanding of the issue by technicians and other supervisory staff and their active involvement are extremely important to pursue EEMs for desired results on a sustainable basis.

Some of the measures like adjustment of air-fuel ratio, and control of parasite air and cooling air are dependent on the control exercised by the operator on the process-control parameters. The production and operational personnel, therefore, need to be trained on the rudiments of the energy-efficiency component of the process control and how to optimize energy consumption without compromising on the quality of the product while achieving the programme objective. With this aim in mind, training programmes were conducted for three days at each of the three clusters— Khurja, Morbi, and Thangadh during July–August 2009 for kiln-operating personnel and maintenance personnel. The programme included classroom and field observations and demonstrations, and provided hands-on training on the various aspects of energy efficiency. The training capsule was developed keeping in mind the educational background of the targeted audience. As many as 41 supervisors and kiln operators in Morbi, 28 in Thangadh, and 21 in Khurja attended the training programme. The training was conducted by trainers from Shri Shakti Alternative Energy Ltd, Hyderabad.

Demonstration sessions were conducted on use of instruments including measuring the readings and adjustments of different controls in roller and tunnel kilns; practical aspects of energy management in kilns; energy audit, monitoring, and targeting; kiln firing systems, burners, kiln furniture, and energy-efficient operation of ceramic kilns; and heat losses in ceramic kilns, combustion (basics), and instrumentation. As part of the practical aspects, energy audit instruments were demonstrated in 10 units at Morbi, 12 units at Thangadh, and 11 units at Khurja. During the programme, some of the entrepreneurs exhibited keenness to procure instruments essential for monitoring and optimizing energy consumption in the kilns.

To this end, M/s Nevco Engineers Pvt. Ltd was invited to provide a quotation for the essential instruments. The quotations were further discussed by the entrepreneurs at Morbi and Thangadh with the representatives of Nevco, and a 10% discount was assured by the supplier on an order of 8–10 sets of instruments. It was also considered that only flue gas analyser and differential pressure meter could be procured initially.

The programme also provided training to local service providers in energy efficiency so that they could keep regular tabs on the participating units and guide them in implementing routine EEMs The local service providers would be able to provide their services to other units from the cluster and disseminate the benefits to all the units in the cluster. This will also be an exercise for local capacity development

It is noteworthy that all logistic-related costs, as well as opportunity costs for the units' personnel attending the workshop for all three days were borne by the units themselves.

4.3.10 Introduction of lean manufacturing concept

Lean manufacturing is an important and emerging concept practiced world over for minimizing wastage in manufacturing process and increase productivity and cost competitiveness of units.

Lean Management/Total Quality Management (TQM), a new paradigm for national and international competitiveness improvement, was identified as one of the activities for improving the quality and productivity for Jallandhar hand tool cluster under the Project titled "National Programme for Promoting Energy Efficiency in Hand Tools SSI Sector in India", undertaken by UNIDO during 2003-2007. The concept of good manufacturing practices and lean manufacturing through TQM/TCM Programme was introduced for the first time in the Jallandhar cluster.

The industry showed keen interest in adopting lean management in manufacturing to improve their competitiveness. Ten hand tool units from Jallandhar cluster committed to move forward to achieve the excellence in manufacturing were assisted for implementation of TQM/Lean manufacturing and Total Cost Management (TCM) programme. The experts from Confederation of Indian Industry (CII) assisted the selected units in implementation of TQM and TCM programmes.

The programme was implemented over a period of 12 working months from March 2006 to June 2007. The main focus of the programme was to achieve manufacturing excellence by determining the areas involving improvements and actually implementing the identified areas on the shop floor to take them to newer heights of excellence. The issues related to productivity improvement due to labour efficiency, production process improvement, and cost reduction were taken up through TQM interventions by implementing techniques like 5S, 3M, Pokayoke, Kiazen, total preventive maintenance, single minute exchange of dies (SMED), flow manufacturing, and so on. Similarly, issues related to product wise and activity wise cost measurements for profitability analysis were taken up through the TCM programme.

The interventions under the TQM/TCM and other aspects of lean manufacturing carried out by the Jallandhar Hand Tools Cluster, through the CII were found to be very beneficial to the participating units. In the MRM (management review meeting) held on 22 February 2007, the entrepreneurs presented the benefits accrued to them under the programme with lots of pride.

Encouraged by the positive response from the hand tools sector units in Jalandhar, it was proposed to expose the units participating in the ceramic programme and other units of the clusters to the concept of lean manufacturing through awareness workshops. The local associations very much appreciated the idea and suggested to organize the workshops during April 2007. Following this, the concept of lean manufacturing was introduced in the three clusters—Morbi, Thangadh, and Khurja—with the objective of reducing manufacturing costs and enhancing cost competitiveness among the units.

UNIDO, in consultation with Morbi Dhuva Glaze Tiles Association, Morbi, and Sanitary Wares Manufacturers Association, Morbi, introduced the concept of lean manufacturing to the ceramic units of Morbi during a daylong seminar on 6 April 2007.

In Thangadh, the concept was introduced in consultation with the Panchal Ceramic Association (Vikas Trust), Thangadh, and the Federation of Ceramic Industries, Thangadh, through an 'Awareness Programme on Lean Manufacturing techniques' on 7 April 2007. In Khurja, the workshop was held on 14 April 2007.

M/S Q-spread, New Delhi, a renowned consultancy firm in the field of lean manufacturing practices, was employed to introduce the concept in all the three clusters.

The awareness programme covered the following important aspects, amongst others.

- Lean thinking and the five pillars of lean manufacturing
- Simulation of lean factory
- Manufacturing waste
- Introduction to lean toolkit (Kaizen, 5S, Pokayoke, Visual controls, Standardization, SMED, and so on)
- Lean implementation—issues and strategies

Thirty-five entrepreneurs attended the workshop at Morbi, while 30 each were present at the Thangadh and Khurja workshops. The local associations took care of all the expenditures on venue, sound system, lunch and tea /snacks during the workshops.

During these workshops, it was realized that the introduction of lean manufacturing techniques in other SSI clusters such as in the hand tools SSI cluster at Jalandhar, Punjab, has proven to be beneficial and has helped the entrepreneurs in appreciating the merit of lean manufacturing in their efforts at becoming cost competitive.

Interactions with industry representatives indicate that some of the concepts of lean manufacturing have been adopted by a number of units in the three clusters. However, a detailed study would be required to capture and quantify the actual impacts of the project intervention.

4.3.11 Establishing common testing facility

A common testing facility centre was to be established for the SMEs at Khurja (Uttar Pradesh).

During the execution stage, it was noted that a common testing facility was already present at CGCRI, Khurja. Since all ceramic units of Khurja could avail of its services, hence, no further action was initiated to establish a separate testing facility.

However, to augment the efforts of CGCRI, Khurja, sophisticated and advanced testing equipments were proposed to be provided to NCB, Ballabgarh, Haryana. At NCB, not only was enough technical manpower to manage the equipments available, but it was also felt that these equipments could be put to optimum use by the local ceramic units, cement units, and refractory manufacturing units.

4.3.12 Capacity-building measures for supporting institutions

4.3.12.1 Developing and demonstrating rapid-firing technology in ceramic industry

Towards meeting the objective of capacity-building of the counterpart national institution, support was provided to CGCRI, Khurja, to develop rapid-firing technology in

order to help promote the use of energy-efficient roller kiln for manufacturing tablewares.

Under the Assistance to States for Developing Export Infrastructure and Allied Activities (ASIDE) scheme, initially, two firing trials were conducted using traditional body (white ware ceramic composition). The cool-to-cool firing cycle was for four hours. It was observed that the results were not satisfactory as traditional body was not suitable for the fast-firing cycles. The ratio of fuel consumption was 0.49–0.52 kg LPG gas/kg fired product. After carrying out two firing trials, a decision was taken to develop a fast fired body (white ware ceramic composition) and conduct more firing trials to optimize the firing hours (cool-to-cool) and LPG consumption (l/kg).

Cordierite kiln furniture was purchased for conducting the firing trials by loading the product in double-deck pattern and optimizing the LPG consumption. The results achieved during the third trial, as per the report received from CGCRI Khurja, are extremely encouraging with respect to the quality for four hours (cool-to-cool) firing cycle.

It is worth mentioning that only the cost of fuel consumed during the trials was met out of the project funds. All other costs such as that on manpower, materials, logistics, and others were borne by CGCRI, Khurja.

The developed technology was disseminated through a workshop on "Development of Fast Fired Body through Firing in Gas Fired Roller Hearth Kiln" on 27 August 2008. About 43 potters participated in the programme, appreciated the work, and discussed the developed technology. As this is an LPG fired Roller Kiln commissioned by CGCRI, MSMEs would like to implement the same upon assured supply of LNG to the cluster. M/s Adani Energy Ltd will be supplying LNG to the cluster most likely by March 2011. However, as on date none of the units have implemented this technology. (See Annexure8)

4.3.12.2 Purchase of equipments

The National Council for Cement and Building Materials (NCB), Ballabgarh, Haryana, is an important national institution under the aegis of the DIPP, Government of India. It plays an important role in cement and other building materials industries.

The NCB had initiated a proposal for procurement of equipments in the ceramic industry for capacity building to accomplish the goals of the programme on a sustainable basis. Accordingly, it was decided to procure essential equipments as per the technical specifications finalized during consultation with officials of the NCB. The main objective of the procurement of equipments is capacity building of a national institution in the fields of quality standards and energy efficiency in ceramic industry, so that post completion of activities and interventions under the programme, the industry continues to receive support.

The institution plays a significant role in imparting training to ceramic SMEs in energy-efficient technologies. Another important factor for provision of equipments to the institution was to augment and supplement the efforts of the CGCRI, Khurja, and

establish a common testing facility, which could be used by the ceramic, cement as well as refractory manufacturing units.

Equipments purchased

1. Dilatometer
2. Thermal conductivity equipment
3. PCE furnace

The need for these equipments was felt during interaction with the ceramic industry, and it was realized that availability of testing facility with these equipments will be beneficial to the industry in terms of quality standardization and energy efficiency.

Dilatometer

The dilatometer is a device used to gauge dimensional changes in ceramic materials, particularly in glazes and the body of ware, be it crockery ware, tiles, sanitary ware or insulators. Upon interaction with the ceramic industry, the need for such testing equipment was felt, when it was realized that it could be of great help in understanding thermal expansion of glaze and body. It was also understood that it would be possible to reduce to minimum ceramic wares with rejection, and improve quality besides provide avenues for energy efficiency by way of predetermined and controlled firing schedules. At present, the industry is dependent on a trial-and-error method with no scientific basis; and hence, there is a need for a scientific method to evaluate the materials. Once the equipment is commissioned and its utility in practical terms is displayed to the industry, both small- or medium-capacity industries would be encouraged to evaluate their materials, modify their mix-and-firing schedules to achieve lesser rejection, improve quality, and achieve better energy efficiency. Besides providing the above benefits, the precision firing schedules and lesser rejections shall additionally result in lower CO_2 emissions, which is the need of the hour. Therefore, the versatile dilatometer is an equipment that will provide valuable information for raw materials and their processing, thereby resulting in gainful outcome for the industry.

Thermal conductivity equipment

While interacting with the industry, it was generally felt that these units—particularly the ones at Khurja—do not apply any scientific method to measure heat losses occurring through the walls of the kilns/furnaces. In any ceramic industry, be it pottery, glass, sanitary ware, tiles, bricks or insulators, the operations necessarily involve heating—in various types of kilns or furnaces—either continuously or intermittently. Therefore, to achieve the desired thermal efficiency and to ensure that heat losses through the surface of kilns or furnaces are within preferred limits, it is necessary to know the thermal conductivity coefficient of the material used to construct the kiln or furnace. This testing is not only useful to gauge the estimated heat losses through the walls of the lining, but it is also necessary to understand their interim evaluation at regular intervals to evaluate the change in coefficient of conductivities during use over a period of time. Thermal conductivity of materials is measured using thermal conductivity equipment, which is a compact unit designed as per IS:1528. This test, therefore, shall be of immediate use for the industry because every unit, be it small or medium-sized, would want to estimate the thermal health of their kilns or furnaces. Hence, it is expected that the demand for this testing shall grow manifold in future.

PCE furnace

This equipment is used to determine the pyrometric cone equivalent (PCE) of ceramic/refractory materials. The furnace is designed and testing is carried out as per IS 1528 (part I):1983. This is one of the basic and most important testing methods regarding fusion and softening behaviour of ceramic/refractory materials. If the industry knows in advance the fusion behaviour of materials they intend to use, then they have an option to utilize or reject the same depending on their thermal behaviour. The need for such testing is natural and obvious, and therefore, its demand is bound to rise in future. During interaction with the ceramic industry, it was confirmed that this testing will be useful to them in selecting the most suitable raw materials for their use in tableware, tiles, sanitary ware, and so on.

The equipments are to be installed at National Council for Cement and Building Materials, Delhi Mathura road, Ballabgarh, Haryana. The target beneficiaries of the initiative are the ceramic, refractories, cement and related industries from all over the country. The equipments would be used by the units during the second phase of the UNIDO project.

4.3.12.3 Participation in International Technical Conference at Dresden, Germany

Two officers from NCB were deputed to participate in the 10th Unified International Technical Conference on Refractories (UNITECR 2007) held at Dresden, Germany during 18–21 September 2007.

UNITECR, one of the principal technical events in the field of refractories, is held once in two years. Participation in the event was undertaken to raise the current level of Indian knowledge in ceramic/refractory science at par with international standards. It was also viewed as a capacity-building measure for project partners and national institutions.

During their visit, the delegation had the opportunity to attend various sessions on technical development in the field of refractories, current benchmark of consumption of refractory in cement and steel industries in different countries, recycling of used refractory materials to address the problem of disposal, and so on. The industry is in the process of developing technology that would enable it to undertake 100% recycling. At the moment, only about 25% of used refractory is being recycled.

Concurrently, an exhibition showcasing new equipments, updated technologies, and raw material was held. The major emphasis of newer technologies and application of raw material was to enhance the longevity of refractory in different industries.

Recommendation and follow-up action

It would be desirable for NCB to pursue various technological developments in the field, particularly, developments in the field of recycling of used refractory to address the problem of disposal as well as conservation of raw materials.

4.3.12.4 International linkages

As part of international linkages, the following activities were taken up under the project.

4.3.12.4.1 Exposure visit-cum-study tour to China

Based on the recommendations of the units during the diagnostic studies and stakeholder meetings, a 22-member delegation (including 18 ceramic manufacturers) of Indian ceramic industry visited China for an exposure-visit-cum-study-tour of ceramic manufacturing units from 31 May 2007 to 5 June 2007.

During the visit, the delegation had the opportunity to:

1. Visit the 21st China International Ceramics Industry exhibition at Guangzhou
2. Visit ceramic manufacturing units at Foshan and Chouzhou
3. Visit ceramic city centres at Foshan and Chouzhou
4. Interact with technology suppliers on different aspects of kiln and other equipments used in ceramic units

The salient observations during station-wise visits to different facilities were:

Guangzhou (1 June 2007)

21st China International Ceramics Industry Exhibition, Guangzhou

The delegation received an invitation from M/s Foshan Kexinda Aosibo Ceramic Technology Co. Ltd to visit the exhibition. The focus of the display in the exhibition was on raw material and technology to process different ceramic products. The members spent a day at the venue, going through the items of their interest on display.

Amongst many innovative ideas showcased at the exhibition, mention must be made of MaxxMill, an energy-efficient grinding technology from M/s Eirich, a German firm. In a conventional ball mill, 18–20 hours of operation is required to achieve the desired fineness (about 65% material of less than 5 micron size for slip in sanitary ware) of the material. In the ball mill, initial grinding of up to 100 micron, for example, is fast (3–4 hours), and then the slow process of grinding to achieve the desired fineness takes around 14–16 hours.

The innovative agitated media mill, brought out by M/s Eirich, reduces these 14–16 hours of grinding to mere minutes, thereby saving energy. It is indeed an innovative concept, but an expensive one in the context of the present scale of operation of Indian units.

Foshan (2–3 June 2007)

Foshan is famous for ceramic tiles, sanitary wares and ceramic technology/equipments. The Foshan Ceramic Research Institute functions along the same lines as India's Central Glass and Ceramic Research Institute. The difference between the two lies in the fact that the Foshan Institute manufactures and markets its products in order to be self-sufficient.

(i) Foshan tile manufacturing factory, Foshan

Due to heavy rains and consequent flooding of the premises, only a part of the factory could be seen during the visit. The members of the delegation from tile manufacturing

units reached a conclusion that the technology pursued by them compared quite well with that of China. One obvious difference was in terms of shop floor management.

(ii) Arrow Sanitary Ware Factory, Foshan

It is one of the large factories of the region, with around 4000 employees. Members of the delegation from sanitary ware units visited the factory to take a look at the different manufacturing operations. One of the most striking observations was that there was virtually no parasite air in the kiln system. There was no hot air escaping through the exit and other openings. This signifies absence of excess air in the combustion system. On the other hand, in Indian ceramic units, there is so much air in the system that the hot air escapes from both entry and exit of tunnel kilns. The Indian entrepreneurs justify excess air in their kilns as a measure to ensure heat flow and uniformity of temperature, thereby burning more fuel in the process. The observation helped them appreciate the scope of energy saving by reducing the percentage of air in the combustion system, an aspect strongly recommended in the energy audits of the selective units.

(iii) Foshan Kexinda Aosibo Ceramic Technology Co. Ltd, Foshan

One of the leading technology supplier/exporter of kilns, glazing equipments, and ball mill machinery for ceramic units, M/s Kexinda is an equipment exporter to the Indian ceramic industry. It collaborates with M/s Drayton Beaumont Kilns Ltd of United Kingdom in manufacturing different type of kilns.

Delegation at Foshan Kexinda Aosibo Ceramic Technology Co. Ltd, Foshan

The delegation visited two of their manufacturing facilities and interacted with Mr Advi Qin, Technical Manager, and other managers of the firm. During the discussion, the members of the delegation who were operating tunnel kilns expressed their keenness for inputs on systematic and well-designed refurbishing/replacing of their existing kilns. Generally, the SSI ceramic units opt for locally-made tunnel kilns that are mostly fabricated without any design input.

Mr Qin agreed to interact with his counterpart in Drayton Beaumont Kilns and promised to send a proposal on receipt of a formal proposal from the units/UNIDO.

(iv) Ceramic City Centre, Foshan

It is renowned for display of beautiful ceramic products manufactured at Foshan. The entrepreneurs got the opportunity to view a number of simple but elegant designs that can be easily replicated in India.

Chouzhou (4–5 June 2007)

Chouzhou has two distinct ceramic clusters—one manufacturing sanitary wares, and the other manufacturing tablewares. The delegation visited the following factories:

(i) Chouzhou MUYE Ceramics Manufacture Co. Ltd

The unit is engaged in manufacturing sanitary ware products. The arrangement for quality checks and other aspects of shopfloor management and safety practices were quite impressive. The unit is engaged in exporting finished and packed products to Indian manufacturers of high repute.

(ii) Shengtai porcelain craft factory, Fuyang Chaon

A small unit, engaged in manufacturing medium-range tablewares and exporting to manufacturers world over**.** The technology pursued was quite similar to ceramic units at Khurja, except that electricity is used for the third stage, post decoration firing. This aspect, along with the quality of raw material, is the main reason for superior quality of Chinese ceramic tableware products.

(iii) Chouzhou Huali ceramics factory

Another small unit, engaged in manufacturing quality bone china crockery/tableware products. The unit employs state-of-the art technology and uses roller kiln to fire post-decoration third-stage firing. The delegates from Khurja witnessed some extremely informative technology applications in grinding medium for glaze, finishing of the products after second stage of firing, and so on.

Delegation at ceramic factories in China

Recommendation and follow-up action

(i) It would be desirable to pursue with M/s Eirich, Germany, and explore the possibility of a customized MaxxMill suited to the scale of production of Indian units as an energy-saving measure.

(ii) It would be desirable to invite M/s Kexinda and M/s Drayton Beaumont to pay a visit and recommend measures to refurbish or replace the existing kilns. This would also act as an international input in the programme in demonstrating energy saving and other benefits in a well-designed kiln.

As a capacity-building measure for the project counterparts/national institutions, and supporting institutions, scientists from Central Glass and Ceramic Research Institute, Khurja, Uttar Pradesh, and Naroda, Gujarat, and National Council for Cement and Building Materials, Ballabgarh; and representatives of local-industry associations also took part in the visit.

The visit was successful as it enabled the delegates to understand and appreciate new and energy-efficient technologies displayed at the exhibition, and various quality control measures and shop floor practices of the Chinese ceramic industry at Foshan and Chouzhou.

4.3.12.4.2 Visit to Dresden, Germany

International exposure was provided to two officers from NCB through their participation in the 10th Unified International Technical Conference on Refractories (UNITECR 2007) at Dresden, Germany from 18–21 September 2007.

During their visit, the delegation had the opportunity to attend various sessions on technical development in the field of refractories, current benchmark of consumption of refractory in cement and steel industries in different countries, recycling of used

refractory materials to address the problem of disposal, and so on. The industry is in the process of developing technology that would enable it to undertake 100% recycling. At the moment, only about 25% of used refractory is being recycled.

The NCB officers also visited a concurrently-organized exhibition that showcased new equipments and technologies, and raw material. The major emphasis of newer technologies and application of raw material was on enhancing the longevity of refractories in different industries.

Exposure visit of NCB officials to Dresden, Germany

Recommendation and follow-up action
It would be desirable for NCB to pursue various technological developments in the field, particularly, developments in the field of recycling of used refractory to address the problem of disposal as well as conservation of raw materials.

4.3.12.4.3 Participation in international exhibitions

With the objective of providing international exposure and access to new markets, the selective ceramic units participated in the Coverings Fair 2008 at Orlando, USA.

Coverings Fair is one of the most important exhibitions on tiles and stone slabs that caters to the USA, central American countries and West Indies. Based on the recommendation of the selective ceramic units from Morbi, it was decided to organize participation in Coverings 2008 held at Orlando, Florida, USA, from 29 April to 2 May 2008.

UNIDO secured 200 ft^2 of space from the show organizers and assisted the participating units in arrangement, construction, and decoration of the booth, furniture, and display of products. Despite refusal of visa to many prospective participants, five representatives from the following four ceramic units of Morbi participated in the fair and displayed their products and catalogues in the exhibition.

1. M/s Face Ceramic Pvt. Ltd, Morbi
2. M/s Deco Ceramic Industries, Morbi
3. M/s Sonex Ceramic, Morbi
4. M/s Stonex International, Morbi

Mr N N Prasad, Joint Secretary, DIPP, led the delegation of the Indian ceramic units.

Major ceramic nations such as Italy, Spain, China, Brazil, and Portugal displayed their ceramic tiles and bath products at the national pavilions. Ceramic products from India were exhibited only by the aforementioned four units.

A large number of important business prospects visited the booth and looked at the range of ceramic wall and floor tiles on display. The visitors were generally appreciative of the quality and cost of Indian ceramic products. Some of the prospective buyers even suggested minor changes in the designs. The participants reported that during the discussions with many visitors it was apparent that business orders of significance might evolve in the near future. The buyers from West Indies and Central American Countries, in particular, were appreciative of the colourful Indian tiles on display.

Ceramic unit owners showcasing their products at the Coverings Fair, Orlando, USA

Some of the business visitors during their interaction with the delegation suggested that for better acceptability in the US market, Indian units need to work on design and style of products. It was also recommended that for pan-American reach, Indian ceramic units must participate in other equally important exhibitions on fabrication and design of kitchen and bath ware—the Surface Fabrication and Design Expo at Las Vegas during 19–21 February 2009. It was revealed that clients visit this event to select products for new projects.

During their discussions with Mr Prasad, the representatives of the participating units mentioned that the high cost of road transportation of containers from factories to the Indian ports put them at a disadvantage vis-à-vis competing nations such as China. The cost will reduce if the container transportation is conducted via railways. Rail link to Kandla/Mundra port lies close to Morbi. The representatives stated that establishing rail

connection from Morbi with this existing link either at Madia or Halvad will boost exports from the Morbi cluster.

The participating units displayed their products at the international exhibition for the first time and were extremely appreciative of the efforts put in by UNIDO and DIPP, government of India in providing them with the opportunity to explore an important market through such an important exhibition, and compare the cost and quality of their products with that of competing nations.

Recommendation and follow-up action

(i) International exhibition appropriate for display of ceramic products from Khurja to be finalized in consultation with the entrepreneurs of the participating units, and their participation arranged.

(ii) Intervention in matters of design and style suitable for the US market could be organized under the programme. Advice from international experts in this regard might prove to be effective.

(iii) Subject to availability of funds and support/approval of DIPP, the units from Morbi may be assisted in their participation in Surface Fabrication and Design Expo, CAPEXIL; Export Promotion Council for ceramic products can be approached to consider participation in this event as one of their approved activities.

4.3.12.4.4 Visits of international experts in kiln technologies

During the exposure visit-cum-study-tour to China in May 2007, the entrepreneurs of the units expressed interest in organizing inspection of the Indian ceramic units by international kiln experts/manufacturers to enable them to understand the shortcomings and take remedial measures for improving the kilns.

Accordingly, in March 2008, experts from M/s Beaumont Kilns Ltd, UK, and M/s Kexinda, China were invited to visit factories of 17 selective ceramic units at Morbi, Thangadh, and Khurja. M/s Beaumont Kilns Ltd is the pioneer in the field of continuous and intermittent kilns. It might also be mentioned that M/s Kexinda and M/s Beaumont had established a joint venture.

The visit intended to identify major technology-gap between the kilns in Indian ceramic SSI units and their counterparts in developed countries. An important outcome of the visit was that the entrepreneurs of the selective ceramic units were motivated to improve their kilns on the basis of expert inputs.

The delegation of international experts (mentioned below) visited the factories of the units during 27–31 March 2008

1. David John Mellor, Project/Sales Engineer, Drayton Beaumont Kilns Ltd
2. Huo Jinrong, Chairman (Directors), Kexinda AOSIBO Ceramic Technology Co. Ltd
3. Huang Guoqiang, General Manager, Kexinda AOSIBO Ceramic Technology Co. Ltd

4. Wan Zhen, Factory Manager, Kilns branch, Kexinda AOSIBO Ceramic Technology Co. Ltd
5. Xu Jinlong, Interpreter, Kexinda Aosibo Ceramic Technology, Co. Ltd

International experts at ceramic units in Thangadh, Morbi, and Khurja

The expert group visited ceramic units at different locations as per the schedule finalized in consultation with the entrepreneurs. Some of the important observations made by them are given below.

1. The units at Morbi and Thangadh had recently switched from liquid fuel to LNG. Each unit continues to use the old liquid fuel burner with LNG. No efforts have been made to measure and regulate air-and-fuel ratio for new fuel. The significance of proper air-fuel ratio was explained to avoid reduction firing.
2. There is insignificant data to know the efficiency of combustions in the kilns, and, hence, units rely upon visual examination.
3. The kiln furniture is quite heavy.
4. Units do not use waste heat for drying of green ware.
5. Some units have an arrangement to draw hot air from cool zone and supply it to pre-heating zone in an uncontrolled manner. This results in faster cooling but damages the wares. As a result, units have stopped taking advantage of the installation. Units were explained to regulate cooling with the help of mobile thermocouples.
6. Some units try to stack wares in such a manner that heat flow is restricted, thereby leading to inefficient use of heat energy in the kiln. The units were explained to leave space between wares and the wall of kiln for flow of heat energy.

7. Units reported disfiguring of tableware products. It was explained that the cause was infringement of flames. The units were explained to avoid direct contact between flame and products by placing silicon carbide/nitrite baffles in front of burners.
8. Some units pointed out to the problem of discolouring of the products. It was explained that this was due to reduction firing on account of improper air-fuel ratio.
9. Units informed that they fire products with moisture content up to 8%–10%. This is an ineffective use of kiln, as part of preheating zone works as dryer.
10. Some units asked the group of international experts to provide design of a new tunnel kiln to increase output, dryer, and burner with arrangement to set and control air-fuel ratio.

CGCRI is coordinating a project to set up a common facility centre for the Dependent Potters Association at Khurja. A welfare society has already been registered for the purpose. International experts were provided details of different design parameters of the proposed kiln in CFC, so that post-implementation, a tunnel kiln with the design input from international experts is made available at Khurja. This will help in impressing upon the industry the advantage of well-designed kiln in improving quality of products and competitiveness. In case the commercial offer about the same is acceptable to CGCRI and SISI, UNIDO may support the cost of designing such kilns.

4.3.12.5 Improvements in quality and productivity

During the diagnostic studies and energy audits, it was observed that there is general lack of awareness amongst technicians and other staff of ceramic units about the need to adhere to quality standards, testing procedures, and standard shop floor practices to improve productivity and cost competitiveness, and ensure safety.

To help the Indian ceramic industry maintain quality of its products and enhance cost competitiveness, a manual on 'Quality Standards, Testing Procedures and Environmental, health, and safety (EHS) practices for ceramic industry in India' has been prepared as part of the project. The manual is written in vernacular languages – Hindi and Gujarati for the benefit of supervisors, entrepreneurs, ceramists, and others connected with ceramic industry. The manual, developed in association with CGCRI, Ahmedabad, Gujarat, is the first-of-its-kind in India. It is designed as a reference book that introduces the basic quality measures pertaining to ceramic manufacturing to the existing ceramic units in India. The manual addresses the quality issues of ceramic raw materials, manufacturing processes, process controls required at different stages, and quality controls of finished products for the production of sanitary wares, crockery and table wares, wall, floor and vitrified ceramic tiles. It is hoped that ceramic entrepreneurs, technicians, ceramists, and consultants will use it extensively and will find it helpful in their efforts towards further development and growth of the ceramic industry in India. The summary version of the Manual (in English) was released during the project closing workshops held in the three clusters in the month of June 2010. The complete manual, Hindi and Gujarati version, is under process as on date.

4.3.12.6 Cross-cutting theme: Gender strategy to address specific needs of men and women employees working in the ceramic SSI sector: 'Scoping Socially Responsible Behaviour in SMEs in India'

Introduction

In recent years, increasing attention has been given to the concept of Corporate Social Responsibility (CSR), defined in terms of the responsiveness of businesses to stakeholders' legal, ethical, social and environmental expectations. Broadly, CSR is the continuing commitment by business to contribute to economic development while improving the quality of life of the workforce and their families as well as of the community and society at large" (WBCSD)[15]. The concept is equally valid for large and small enterprises since they are an integral part of the societies and communities in which they operate.

"Today, the concept of CSR has gone beyond the traditional philanthropic approach and looks into strategic cooperation. However, the SME sector is yet to consider CSR as a tool for business enhancement. This is mainly because they are forced to prioritize short-term survival over longer-term strategic measures, and they often have few managerial and financial resources to invest in such measures."[16]

To keep pace with the ever-changing and constantly evolving business environment, SMEs need to adopt socially and environmentally responsible business approaches and strategies. "The changing dynamics of business environment, influenced significantly by increasing geographical market access, better logistics, communications and competitive forces have opened avenues and in some cases compelled SMEs to seek better efficiencies and sustainability in their areas and scope of operations."[17]

An enterprise that demonstrates socially responsible behaviour can gain a competitive edge over its counterparts in a variety of ways. Improving its reputation among its stakeholders, it can add to its goodwill, thus securing or expanding its market share. Some of the responsible actions of the enterprise may also become social standards that might serve as barriers to potential competitors in the long run. Thus, mainstreaming socially responsible actions can help SMEs to remain locally and globally competitive. CSR may be viewed as a process to align business to sustainable practices, leading to business continuity and sustainability.

In India, a number of initiatives have been taken to support SMEs develop appropriate, credible and viable approaches to CSR. The concept of CSR is high on the Government's agenda. This has become all the more relevant in the context of the recent economic meltdown, which has compelled corporates, small and large alike, to look into not only the immediate gains but also the long-term viability, by internalizing socially responsible behaviour in their operations.

15 Details available at <www.wbcsd.org/templates/TemplateWBCSD5/layout.asp?type=p&MenuId=MTE0OQ>, last accessed on 30 June 2010.

[16] Details available at < http://smetimes.tradeindia.com/smetimes/news/top-stories/2010/Apr/22/teri-and-hsbc-incentivise-smes-for-csr-efforts61298.html>, last accessed on 4 June 2010.

Further, with the international regulations becoming more stringent, the large corporates have already started translating their pressure to SMEs who are part of their supply chain as a result of which, a limited but growing number of SMEs have started thinking about integrating CSR into their business practices. With the upcoming voluntary ISO SR 26000 guidelines, to be released in September 2010, the pressure on the SMEs to be socially responsible would only increase in future.

Further, the Ministry of Corporate Affairs has recently come up with the voluntary CSR Guidelines for the corporate sector in India with the aim of fostering inclusive growth. The guidelines, applicable to all corporates, irrespective of their size, would drive forth the agenda of inclusive growth.

CSR study

The SME ceramic sector is a major player accounting for more than 50% of the market share in the Indian ceramic industry.[18] As per the Indian Council of Ceramic Tiles and Sanitary ware, India is one among the top five countries in terms of tile production globally.[19] However, it still faces stiff competition from international markets on quality and price. The SME units do not have sufficient technological, financial and institutional capacity to upgrade and modernize their technology and production processes often finding it difficult to compete in the international market.

In India, though ceramic units are scattered all over the country, the industry has developed in clusters such as Khurja in Uttar Pradesh for crockery and allied items; and Morbi and Thangadh in Gujarat for tiles and sanitary ware, respectively. These three clusters support majority of the market share for ceramic products in India.

Given the potential in the ceramics sector in terms of growth and exports, the Department of Industrial Policy and Promotion, Government of India, jointly with UNIDO, initiated a project titled 'National Programme to Support Energy Efficiency and Quality Standards in Ceramic SSI Units in India' for promoting energy efficiency in SMEs in the three ceramic clusters, namely Khurja, Morbi and Thangadh. The project envisaged introduction of energy efficient technologies and other measures to bring about substantial savings in energy consumed and overall improvement in quality standards of SSI units, thus resulting in enhancing their competitiveness besides improving the local environment.

Though a lot of information and documentation is available on the responsible corporate behaviour, it is mostly about the large enterprises. Not much information exists on the socially responsible practices prevalent in the SMEs. With this background, a study titled 'Scoping Socially Responsible Behaviour in SMEs in India' was undertaken by TERI with the aim of looking at the CSR elements in these three ceramic clusters. The study added to one of the cross cutting themes—gender strategy to address specific needs of men and women employees working in the ceramic SSI sector—under the larger UNIDO

[18] Details available at <www.imsme.org/Uploads/MediaTypes/Documents/National_%20program_%20Ceramics_SMEs.pdf>, last accessed on 30 June 2010.

[19] Vancheswaran A and Gautam V. 2009. An appraisal of CSR in SMEs in a globalized context: an empirical study of a ceramic cluster in Morbi, India. International Journal of Globalisation and Small Business 3(4): 441-462

project by following cluster approach and networking with all key stakeholders to expedite the adoption and replication of new and efficient technologies and measures.

This study sought to determine the importance of CSR as a strategic tool for enhancing the overall commitment of the SMEs and ensure their social impact and contribution at a larger level. The study further aimed to sensitize smaller units on the "significance of CSR in development of cluster/industry".

The objectives of the study carried out by TERI in partnership with UNIDO were:

To develop a general understanding of the selected SMEs, focusing on the way in which they address social responsibility issues (labour, health and safety, and environment) and core business issues (productivity, wages and working hours, quality, and human resource management).
To improve their overall competitiveness in a socially responsible way, and, therefore, integrate more successfully and sustainably into national and international supply chains.

The scoping study focused on reviewing and assessing the CSR activities adopted by SMEs at the three clusters. The study involved focussed group discussions with the unit owners at each of the three clusters in order to explain to them the merits of the study and in turn get their consent to participate in the study followed by workshops. This initial interaction with the units also helped in firming up the questionnaires that were designed based on the study objectives to explore the presence of CSR in the cluster.

Further, in close consultation with cluster-level association representatives and based on the willingness of the firms to participate in the study, 30 units, as per on the MSME Act 2006,[20] were identified. This was followed by selection of contractors, workers and workers' families from the units, which had given their consent for the study.

The first phase of the study was descriptive and involved administering questionnaires with the unit owners, contractors/supervisors and the workers and their families. Site visits were undertaken for collecting primary data and validating the secondary data. The major tools used for data collection comprised key person interviews, focus group discussions, stakeholder consultations, and so on. The focus group discussions were conducted primarily to ascertain the stakeholder's aspirations, needs and attitudes toward cluster CSR programmes.

The study helped in developing a greater understanding on how the SMEs and the clusters engaged themselves in collective actions to address social responsibility and core business issues. This in turn, may be interpreted as 'silent CSR' that if institutionalised, could be a process to align business continuity and sustainability.

Conclusion
The three ceramic clusters surveyed for their socially responsible behaviour brought to fore various positive trends and challenges.

[20] Government of India, MSME (micro, small and medium development) Act 2006, which considers a manufacturing enterprise having an investment between `2.5–100 millions in plant and machinery as a small enterprise

Unit owners

- It was observed that each cluster's strategies for socially responsible activities (such as education, mid-day meals, festival celebrations, health, and so on.) were largely sporadic and driven by the individual enterprise owners. These had less to do with stakeholder involvement; rather it was chiefly driven by the vision of the enterprise owner to build goodwill among the community in which it operates.

- The adoption of codes and standards within the clusters was encouraging. Majority of the enterprises did not have a 'company policy for CSR and environment'. However, they were aware of what goes into a company policy and mentioned that they imbibe them in their day-to-day operations. It also brought to fore that, the units aligned themselves to CSR practices only if they perceived direct benefits or threat to their business.

- All units maintained attendance records for their workers. However, the clusters were weak in documentation and maintaining records such as workers' ID cards, working contracts, pay slips, and so on.

- Most of the units in the clusters were using basic ICT facilities. Use of advanced ICT can be helpful in increasing the market share of the units.

- The enterprise owners in all the three clusters were keen to understand ways and means to reduce their environmental footprints through improved technologies and processes.

- As identified during the diagnostic studies in the clusters, the units need to work towards Total Quality Management in order to manage their resources and business processes, thereby improving their business efficiency and competitiveness in the long run.

- The units in the three clusters scored low in adoption of good Occupational Health and Safety (OHS) practices. There is scope to improve housekeeping in the units as this is an essential part of a safety system. Addressing the issue of space constraint in moulding areas, poor aisle space and high amount of silica dust in the factories, poor lighting, and so on. would not only provide a good work environment, but also bring down the accident rates.

Cluster/association

- The local associations, academic and research institutions near the cluster are supportive in building capacities of the units on various aspects such as product improvement, machine maintenance, energy efficiency, and so on. The associations also promote and facilitate interactions among individual units within the clusters for dissemination of information.

- The cluster-level associations facilitate individual enterprises' interactions with local and state governments and various development organizations, on issues related to enterprise administration (including human resources, financial management, and

legal matters), technology development and adoption, lobbying for policy change, and so on.

Workers

- A significant number of the workers were migrants and received more than the statuary minimum wages. Further, overtime was not encouraged in the units and workers were offered leaves on religious observations, statutory holidays and for personal emergencies. However, high attrition rates were observed in Khurja.

- There was no incidence of child labour. Most of the workers' children go to school. However, some of the children accompanied their parents to work.

- All workers had access to clean potable drinking water and toilets.

- There was no reported incidence of sexual harassment or deviation in compensation/benefits based on gender, religion, caste, health status, and so on in the clusters.

- Community policies in the clusters were weak. Although unit owners enjoyed good rapport with the workers, there were no self-help groups, women groups or close ties with NGOs around the clusters. Such groups are essential to address issues and concerns of the workers.

As provided in the case studies and mentioned above, there is a strong prevalence of 'silent CSR' in the cluster. However, many a times, the unit owners are reluctant to share information on the same due to strong religious beliefs. Institutionalizing CSR within the units can help SMEs to remain locally and globally competitive as also make the enterprises committed to the social and environmental causes from one generation to another on a sustainable basis rather than leaving the initiatives to be taken forward by individual owners, which are generally ad hoc and sporadic in nature.

Way forward

The CSR agenda in India is in the process of transformation. While the CSR multi-stakeholder approach is gaining ground at global level, business self-regulation is still dominant in India. As illustrated in the case studies, majority of the socially responsible initiatives are taken up by individual units and are sporadic in nature. As a result, they lack momentum, impact, and sustainability.

The process of aligning CSR practices within SMEs is at a slow pace, with a very small fraction of units imbibing socially responsible practices within their businesses. With the coming of the voluntary international guidelines, that is, ISO SR 26000, it becomes all the more important for the SMEs, catering to the International markets, to increasingly align socially responsible behaviour in their business in order to retain and expand their share and remain competitive in the global market.

This study 'Scoping Socially Responsible Behaviour in SMEs' is perhaps the first attempt to understand and document CSR practices in the SMEs in Khurja (UP), Morbi and Thangadh, Gujarat. The study has been helpful in adding to the existing repository of the

limited information available in the public domain, thus documenting behavioural patterns and variations in CSR practices for other SMEs to replicate and implement socially responsible behaviour suited to their area of operations. Further, it has brought to fore the collaborative links between cluster-level associations, government and R&D organizations. In addition, it has also provided opportunity to unit owners for gaining insight on various socially responsible activities.

The SMEs, at various levels, require support from the government, research institutions and industry associations, in order to understand their specific needs and assist them in mainstreaming responsible actions within their business.

To tap the potential of SMEs fully, there is a need for discussion and research in academic and management circles on the following aspects:

- A larger mapping of CSR initiatives in SMEs across India through similar studies in order to develop a pool of best practices for developing a nationwide implementable CSR framework for SMEs.
- Need for encouraging civil society organizations, including self help groups and women groups, to strengthen their capacities so as to enable them to participate in the setting of CSR agenda among SMEs in India.
- How effective are cluster associations in influencing the state of CSR in SMEs? Is CSR intervention at a cluster level likely to be more successful than at the level of the firm?
- What are the variables that would influence the adoption of CSR practices by SMEs?
- Developing awareness and sensitization packages for the clusters in the form of capacity building workshops to develop socially responsible practices within the clusters.
- Need for introduction and implementation of an effective human resource management system in SMEs.
- Aligning standards and codes to meet the needs of SMEs.
- Introduction of incentives and training to help with the adoption of technological solutions beneficial to the enterprises.
- Developing stronger linkages with local research institutions such as CGCRI in order to improve the overall efficiency of the units.

(See Annexure9 and Annexure10)

CHAPTER 5 PROJECT ACHIEVEMENTS AND HIGHLIGHTS

The project has been able to achieve the envisaged objectives and the targeted outputs and deliverables in an accomplished manner. The major achievements of the project are highlighted below.

Summary of achievements vis-à-vis project deliverables

- Detailed energy audits of 15 units were conducted to recommend unit-specific energy-efficiency measures. Workshops were held at the three clusters to discuss and explain the recommendations to the unit management and supervisors. A number of units have already commenced implementing the suggestions. The units also contributed to 25% of the consultancy costs for the audits, after being convinced of the merits of the energy-efficiency measures suggested after the audits.

- The 15 representative ceramic units, for which energy audits were conducted, were selected from three clusters for demonstrating energy-efficient technologies and processes, raw material and quality standards, and benchmarked against best in class on technology, quality, and cost effectiveness and marketing linkages. The lessons learned were disseminated to around 100 SME units through training of managers and supervisors on energy efficiency measures, workshops, exposure visits.

- Overall energy savings approximately in the range of 25%, which also corroborates with the estimates outlined in the project document, were achieved as a result of the project interventions—large-scale adoption and replication of energy-efficient technologies and other measures including diagnostic studies, energy audits, quality standards, training and capacity-building, exposure visits to ceramic units of developed and competing nations, and switch over to cleaner fuels. This was substantiated by interactions with the unit owners and respective association representatives over telephone and during field visits towards the closing period of the project. Letters from some of the units which have benefited from the programme are provided in. (See Annexure11 and Annexure12)

- Around 100 entrepreneurs, managers, experts, and planners were trained under the project in energy-efficient technologies, maintaining quality standards of raw material, quality testing and productivity, and market research and strategies. (See Annexure13)

- For the first time, units at all the three clusters were exposed to the concept of lean manufacturing to enhance their cost competitiveness.

- The energy efficiency measures and technologies, best practices, concept of lean manufacturing, and other interventions made under the project have been replicated in a number of units other than those wherein energy audits and demonstrations were conducted. In Khurja and Thangadh, more than 50 units besides the demonstration units have adopted these measures and practices. In Morbi, discussions with unit owners and CGCRI representatives over phone and during field visits in the closing phase of the project indicate, after UNIDO's interventions and

demonstration of the benefits of energy efficiency measures, as on date, approximately, 90% of the total cluster size has shifted from tunnel kilns to roller kilns. Similarly, about 80% of the units have also made improvements in the kiln furniture. (See Annexure12 and Annexure14)

- Effective international linkages were provided through visits to ceramic units of competing nations, visit of international experts to selective units, and participation in international exhibitions and fairs. A 22-member delegation, including 18 unit representatives from the three ceramic clusters and national institutions visited the ceramic industry of Foshan and Chouzhou in China. The delegation also went to the 21st International Ceramic Exhibition at Guangzhou, China. Select units from the clusters were provided access to the USA market through display and marketing of products of Indian ceramic units at the Orlando Fair.

- Two films were prepared under the project. The first film, a documentary on "Ceramic SMEs in India: opportunities ahead" portrays the problems faced by the small-scale ceramic industry in India. It features Interviews with DIPP, UNIDO and CGCRI officials, along with the actual manufacturers providing their views and perspectives on the project activities. The film also showcases the ongoing efforts to bring about energy efficiency in the units. Film II is a documentary portrayal of UNIDO's interventions made during the period (September 2004 to 30 June 2010) in the three clusters, to improve the overall market competitiveness of the cluster units and mitigate greenhouse gas (GHG) emissions by enhancing energy efficiency and overall productivity through standardization of raw materials, finished products, and so on.

- A bi-lingual (Hindi and English) website, with its own URL/domain name, providing information on the project and the ceramic Industry was designed. The website, hosted on the server of DIPP, Ministry of Commerce, Government of India during the currency of the project, proved to be a repository of information for manufacturers, exporters, and buyers of ceramic products in India. There were provisions to update the information from time to time. The technical section of the website contained information about technical matters mostly relevant to the small- and medium-scale manufacturers of ceramic products.

- To help the Indian ceramic industry maintain quality of its products and enhance cost competitiveness, a Manual on 'Quality Standards, Testing Procedures and Environmental, Health and Safety (EHS) Practices for Ceramic Industry in India' has been prepared as part of the project. The Manual is written in vernacular languages – Hindi and Gujarati for the benefit of supervisors, entrepreneurs, ceramists, and others connected with ceramic industry. The Manual, developed in association with CGCRI, Ahmedabad, Gujarat, is the first-of-its-kind in India, designed as a reference book that introduces the basic quality measures pertaining to ceramic manufacturing to the existing ceramic units in India. The Summary version of the Manual (in English) was released during the project closing workshops held in the three clusters in the month of June 2010. The complete manual, Hindi and Gujarati version, is under process as on date.

- No common testing facility was developed at Khurja, as CGCRI, Khurja already had such facility for use by SSI units. However, sophisticated testing equipments have been provided to the National Council for Cement and Building Materials (NCB), at Ballabgarh for advanced testing of ceramic raw material, measuring energy efficiency.

- Institutional capacity built through strengthening testing facilities, training and participation in relevant international conference at NCB, CGCRI and state-level institutions through training workshops and seminars organized under the project.

- In order to build its capacity, CGCRI Khurja was supported in its efforts of developing rapid-fire technology for table wares.

- A study on 'Scoping Socially Responsible Behaviour in SMEs' undertaken in the three clusters to address specific needs of men and women employees working in the ceramic SSI sector.

- Periodic review of achievements undertaken at the project level and on half-yearly basis at the National Project Steering Committee level to ensure effective monitoring and evaluation of the project activities.

- The most important achievement of the project has been the contribution of the units and project counterparts. The units' contribution was in the form of partial financing of activities such as energy audits, study trips, participation in national/international fairs, training programmes, and in technology equipments. One-fourth of the cost of diagnostic studies and energy audits was borne by the participating entrepreneurs. Half of the cost of activities such as organization of workshops, exposure tours/study trips, and participation in international fairs was borne by the associations and entrepreneurs themselves.

Dissemination of lessons learnt

The lessons learnt on improving energy efficiency, technology upgradation, improving quality and productivity, market development, and so on were disseminated through video films, website, Internet, and brochures prepared as part of the project. Information on the interventions has been disseminated to more than 100 ceramic units by means of workshops, training and capacity-building programmes, and exposure visits to international fairs and exhibitions. Post implementation of the programme activities, the local service providers would also offer their services to other units from the cluster and spread the benefits to a large number of units.

Workshop on dissemination of results of CSR study in Morbi

In September 2008, TERI organized a half-day workshop for the ceramic cluster in Morbi with the aim of sharing the findings of the CSR study titled 'Scoping Socially Responsible Behaviour in SMEs' conducted in Morbi cluster and to facilitate creation of women's association to promote workers' welfare. The workshop was well attended by enterprise owners, their wives and the contractors. Representatives from CGCRI, Naroda Centre, Ahmedabad, Sanitary Wares Manufacturers Association, Morbi Dhuva Glaze Tiles Association, and Government of Gujarat, which included the Ministry of Women and Child Development and District Industrial Centre, also participated in the event.

The workshop began with sharing of the survey findings with the respondents. The survey identified some of the inherent socially responsible practices within the cluster such as philanthropy, no child labour, no bias on the basis of caste, gender or religion. The survey emphasized the need for capacity building and training among workers and laid prime importance to setup Human Resources infrastructure in every enterprise. Other sessions during the workshop included a panel discussion, followed by talks by eminent representatives from CGCRI, Naroda Centre and District Industry Centre (DIC) giving talks on promotion of CSR in Morbi cluster.

This was a unique workshop, as for the first time, the wives of the enterprise owners took part in the discussions and expressed an interest in establishing a 'women's association' to facilitate frequent interactions among workers and the enterprise owners. The participants comprising of owners of the enterprise units, their wives and lady members of the house agreed to focus on the human resource dimension and agreed to take up the matter with immediate effect.

Shri Karsanbhai Adroja, President, Sanitary Wares Manufacturers Association, in his address stressed the need for such research studies in the cluster. He further urged all the association members to take serious note of the human resource factor brought out in the study. The enterprise owners discussed "how and why" there was a need to further develop socially responsible practices within their units.

Project closure meetings

After successfully running the “National Programme to Support Energy Efficiency and Quality Standards in Ceramic SSI Units in India”, since 2005, meetings were organized in June 2010 to mark the closure of Phase I of the project.

The meetings were attended by both participant and non-participant units from the three clusters, and representatives from ceramic associations, government institutions, academia, and multi-lateral organizations. The meetings provided an opportunity to share the achievements and outcomes of the UNIDO project including good practices. The interactive sessions provided a chance for partners and participants to discuss potential future support activities. It featured a project overview by UNIDO and a brief analysis of the data gathered during the project. UNIDO also unveiled the summary version (in English) of the Manual on ‘Quality Standards, Testing Procedures and

Environmental, Health and Safety (EHS) Practices for Ceramic Industry in India' developed under the project to help the Indian ceramic industry maintain quality of its products and enhance cost competitiveness. The Manual is written in vernacular languages – Hindi and Gujarati for the benefit of supervisors, entrepreneurs, ceramists, and others connected with ceramic industry. It has been developed in association with CGCRI, Ahmedabad, Gujarat, and is the first-of-its-kind in India. It is designed as a reference book that introduces the basic quality measures pertaining to ceramic manufacturing to the existing ceramic units in India.

Given the successful experience of the current phase of the Partnership Programme, UNIDO confirmed its support to the Ceramic Industry in India with new project activities in 2010/11. Underlining the importance of the Programme, Mr Dolf Gielen (Project Manager, UNIDO) stated that the project as part of its next phase will include PMU at Bureau of Energy Efficiency (BEE), cluster leaders/units, deployment for BAT and develop emerging technologies. Besides, UNIDO has also proposed to partner with IITs and equipment suppliers to develop Technology platforms/incubators.

During the meetings the participants were also made aware of the CSR trends observed in their respective clusters under the study titled 'Scoping Socially Responsible Behaviour in SMEs in India'. The study was undertaken by TERI. Guests were also made aware of emerging technologies, that is, solar dryer for pre-drying, vibro mill for raw material handling (Khurja), Natural Gas fired furnaces (Khurja), high temperature CHP for kilns.

The unit owners, encouraged by the positive outcomes of the project activities, ensured their continued support to the project in future.

Value addition

The Morbi, Thangadh, and Khurja ceramic clusters are characterized by obsolete technologies and energy-inefficient operations. These units usually do not have the capacity to upgrade their production processes, and adopt new and energy-efficient technological options. There is also a lack of exposure to new technology and an enabling environment (in terms of human and institutional development) that can promote technology upgradation in these industries. These SME clusters face stiff competition from international markets on issues related to quality and price.

With this background and considering the significance of energy-efficient technologies and the critical role they can play in making ceramic industries more energy efficient, UNIDO initiated the project on promoting about energy efficiency in the three ceramic clusters.

The project made a significant impact on the ceramic units in the three clusters. Awareness was created among the units on the importance of best practices and energy efficiency measures. Training programmes provided hands-on training on energy-efficient technologies, maintaining quality standards of raw material, quality testing and productivity, and market research and strategies.

For the first time, units at all the three clusters were exposed to the concept of lean manufacturing to enhance their cost competitiveness. In order to build its capacity, CGCRI Khurja was supported in its efforts at developing rapid-fire technology for table wares. To help the Indian ceramic industry maintain quality of its products and enhance cost competitiveness, a manual (in Hindi and Gujarati) was prepared under the project.

The project provided effective international linkages through visits to ceramic units of competing nations, visit of international experts to selective units, and participation in international exhibitions and fairs. Visit of the international experts led to identification of major technology-gap between the kilns in the ceramic SSI units in the three clusters and their counterparts in developed countries, thus motivating the entrepreneurs to improve their kilns on the basis of expert inputs. For the first time, the units displayed their products in the international exhibition, thus getting the opportunity to explore an important market, and compare the cost and quality of their products with that of competing nations.

For the first time, a study “Scoping Responsible Behaviour in SMEs in India” was undertaken with the aim of looking at the CSR elements in the three clusters to address the specific needs of men and women employees working in the ceramic SSI sector to expedite the adoption and replication of new and efficient technologies and measures.

The project has thus brought about substantial savings in the energy consumed, while improving the overall quality standards of SSI units in the three clusters and enhancing the competitiveness of the units.

CONCLUSION

The report seeks to record the accomplishments and lessons learnt from the implementation of the Project. The report is based on the activities and interventions undertaken and accomplishments made to achieve the Project objectives.

A holistic approach was applied for the upgradation of technology in selective ceramic units at Khurja, Uttar Pradesh; Morbi, Gujarat; and Thangadh, Gujarat and improving their competitiveness through adoption of energy efficient technologies and processes and by improving productivity, achieving economies of scale, introducing new designs, training and capacity building, strengthening of institutional structures and encouraging quality controls and adoption of international standards.

During the project, overall energy savings approximately in the range of 25% were achieved through large-scale adoption and replication of the energy efficient technologies and other measures including training and capacity building, exposure visits to ceramic units of developed and competing nations and switch over to cleaner fuels.

The project has a good demonstration effect of improving energy efficiency, quality and productivity of select ceramic units. Subsequent to the diagnostic studies, energy audits were conducted and demonstrations were carried out in 15 representative (in terms of product, technology status, and size of units) ceramic units at the three clusters (8 in Khurja, 4 in Morbi, and 3 in Thangadh) on energy-efficient technologies and processes, raw material and quality standards, and benchmarked against best in class on technology, quality, and cost effectiveness and marketing linkages. Besides the demonstration units, energy efficiency measures have been replicated in more than 100 units in the three clusters.

The project provided effective international linkages through visits to ceramic units of competing nations, visit of international experts to selective units, and participation in international exhibitions and fairs. The visit of the five manufacturers from Morbi to the Coverings Fair at Orlando, Florida, USA provided them the opportunity to display their products in the international exhibition for the first time, thus giving them the opportunity to explore an important market, and compare the cost and quality of their products with that of the competing nations.

Towards building the capacities of the local institutions, CGCRI, Khurja was supported in its efforts at developing rapid–fire technology for table wares. High-end testing equipments, namely Dilatometer, Thermal Conductivity Equipment and PCE Furnace, were provided to the National Council for Cement and Building Materials (NCB), Ballabgarh for advanced testing of ceramic raw material, measuring energy efficiency, and so on.

A study titled “Scoping Socially Responsible Behaviour in SMEs in India” was undertaken with the aim of looking at the CSR elements in the three ceramic clusters. The study added to one of the cross-cutting themes under the larger project—gender strategy to address specific needs of men and women employees working in ceramic SSI sector. The

study is perhaps the first attempt to understand and document CSR practices in the SMEs. The study has been helpful in adding to the existing repository of the limited information available in the public domain, thus documenting behavioural patterns and variations in CSR practices for other SMEs to replicate and implement socially responsible behaviour suited to their area of operations.

Periodic review of achievements was undertaken at the project level and on half-yearly basis at the National Project Steering Committee to ensure effective monitoring and evaluation of the project activities.

The experiences and knowledge gained from various successful activities implemented under the project were documented and disseminated through films which captured the existing status of technology, process, and quality standards at Khurja, Morbi, and Thangadh and provided documentary portrayal of UNIDO's interventions made during the period (September 2004 to 30 Jun 2010) in the three clusters. A dedicated bi-lingual (Hindi and English) website was developed, which acted as a clearing house mechanism for information dissemination. To help the Indian ceramic industry maintain quality of its products and enhance cost competitiveness, a Manual on "Quality Standards, Testing Procedures and Environmental, Health and Safety (EHS) Practices for Ceramic Industry in India" was prepared as part of the project.

One of the major achievements of the project has been the contribution of the units and project counterparts. The units' contribution was in the form of partial financing of activities such as energy audits, study trips, participation in national/international fairs, training programmes, and in technology equipments.

The project has made a great impact on the ceramic units in the Khurja, Morbi, and Thangadh cluster. It has brought about substantial savings in the energy consumed, while improving the overall quality standards of SSI units in the three clusters. The project initiatives have resulted in enhancing the competitiveness of the units and simultaneously improving the local environment. The successful implementation of the project has carved the roadmap for initiating the second phase of the Project in September 2010 in 12 SSI clusters across India, including the Khurja, Morbi and Thangadh. The focus of the Project would be Energy Efficiency and Renewables for SMEs, to be implemented by UNIDO together with the BEE, Ministry of New and Renewables Energy (MNRE), and the Ministry of Micro, Small and Medium Enterprises (MSME).

Annexure 1

List of participants: 'Interaction Meeting of Stakeholders' held in December 2005 at CGCRI, Khurja

Dr R N Pandey	Director, DIPP, Udyog Bhawan, New Delhi
Mr P K Bhatnagar	NCB, Ballabgarh, Haryana
Mr Gulam Kadir	M/s President, KPMA, G T Road, Khurja
Dr P K Gupta	National Cleaner Production Centre, 5–6 Institutional Area, Lodi Road, New Delhi
Dr L K Sharma	Scientist-in-charge, CGCRI, Khurja
Mr Rajneesh Sharma	CII, C/O Jubliant Organosys Ltd, Noida, Uttar Pradesh
Dr Mangal Sen, GM	DIC, Bulandshahar
Mr S P Dadoo	M/s Blue Art Flower Vases, G T Road, Khurja
Mr G D Sinha	Pottery Development Centre, GT Road, Khurja
Mr Jitendra Arora	M/s Shiv Pottery, G T Road, Khurja
Mr A K Paliwal	M/s Paliwal Pottery, G T Road, Khurja
Mr Tanmay	M/s Industrial Ceramics, G T Road, Khurja
Mr Darshan Chhatwal	M/s Chhatwal Ceramics, G T Road, Khurja
Mr J S Minhas	M/s Silicon and Chemico Porcelain Works, G T Road, Khurja
Mr A K Bansal	M/s Gopal Traders, G T Road, Khurja
Mr Karan Gulati	M/s Gulati Ceramics and Industries, Industrial Road, Khurja
Mr Som Datt Sharma	Anupam Ceramics, Munda Khera Road, Khurja
Mr N K Yadav	M/s Pratap Ceramics, Munda Khera Road, Khurja
Mr Sanjay Gupta	M/s New Adarsh Pottery Works, G T Road, Khurja
Mr Girish Agarwal	M/s Jagdish Udyog, G T Road, Khurja
Mr M K Goel	M/s Sapna Ceramics, G T Road, Khurja
Mr Satnam Salooja	M/s Salooja Industries, Munda Khera Road, Khurja
Mr Zakir Ahmad	M/s Zahir Ahmed Pottery Works, Khurja
Mr P L Saini	M/s Tomer Industries, Munda Khera Road, Khurja
Mr Pawan Saini	M/s Saini Industries, Munda Khera Road, Khurja
Mr Naveen Sachdeva	M/s Daya Ceramics, Industrial Area, G T Road, Khurja
Mr Parnesh	M/s Panch Udyog, G T Road, Khurja
Mr Atul Gupta	M/s Akhilesh Industries, G T Road, Khurja
Mr Sandeep Kumar	M/s Viswanath Ceramics, In. Road, Khurja
Mr Sanjeev Batla	M/s Batla Industries, Munda Khera Road, Khurja
Mr Sanjay Gupta	M/s Meena Potteries, G T Road, Khurja
Mr Sanjay Gupta	M/s B I Ceramic Industries, G T Road, Khurja

Mr Anish	M/s Anish Electricals, G T Road, Khurja
Mr Jagdish	M/s Swarg Industries, Munda Khera Road, Khurja
Mr Sanjeev Kumar	M/s Rajeev Pottery, G T Road, Khurja
Mr Gopal Krishna	M/s Universal Techno Industries, G T Road, Khurja
Mr Shakeel	M/s Gio Industries, G T Road, Khurja
Md Sammi Khan	M/s Bharat Tray Star Industries, G T Road, Khurja
Md Asraf Ali	M/s Super Star Industries, Munda Khera Road, Khurja
Mr Ansar	M/s Taj Pottery, G T Road, Khurja
Mr S C Khanna	M/s Maa Shakti Ceramics, G T Road, Khurja
Mr Rajiv Kalra	M/s Kalra Cera Product, G T Road, Khurja
Mr Tirlok Chand Singh	M/s Salooja Raw Material Supplier, Munda Khera Road, Khurja
Mr Pravesh Vaid	Consultant, CII, Noida
Mr Jagdish Saini	Secretary, KPMA, Khurja
Mr A K Asthana	NPC, Utpadakta Bhawan, 5–6 Institutional Area, Lodi Road, New Delhi
Mr Rajeev Garg	NPC, Utpadakta Bhawan, 5-6 Institutional Area, Lodi Road, New Delhi
Ms Swaraj Mainee	Designer, London, swaraj@swarajmainee.com
Mr Jasjit Singh Jutla	Designer, London
Mr S K Chaturvedi	NCB, Ballabgarh, Haryana
Mr A K Gupta	Scientist (Retd) CGCRI, Khurja
Mr Abhaya Sharma	PCRA, New Delhi
Mr Phukan	PCRA, New Delhi
Mr Sandip Garg	PCRA, New Delhi
Mr V P Rastogi	Wesmann Thermal Engg., New Delhi
Dr C S Prasad	Scientist, CGCRI, Khurja
Mr K C Singh	Cluster Development Executive, CGCRI, Khurja

Annexure 2

List of participants at exhibition-cum-study tour to China (May 2007)

Serial number	Name	Address	Contact number
1	Mr Karan Gulati,	M/s Gulati Ceramics A-13, Panchvati, Khurja – 203 131, Uttar Pradesh, India	+919837087311
2	Mr Subhash Khanna	M/S Naresh Potteries, Industrial Area, GT Road, Khurja – 203 131, Uttar Pradesh, India	+919897011106
3	Mr Jitendra Arora	M/S Shiv Potteries, GT Road, near Telephone Exchange, Khurja – 203 131, Uttar Pradesh, India	+919897055507
4	Mr Sanjeev Bansal	M/s Vineet Decorator A-7, Industrial Area, Junction Road, Khurja – 203 131, Uttar Pradesh, India	+919837154823
5	Mr Naveen Sachdeva	M/s Daya Ceramics, Industrial Area, GT Road, Khurja – 203 131, Uttar Pradesh, India	+919837187700
6	Mr Jaswant Singh	M/S Silico and Chemico Porcelain Works, C-5 Industrial Estate, GT Road, Khurja – 203 131, Uttar Pradesh, India	+919837080127
7	Mr Narendra Yadav	M/S Pratap Ceramics, Munda Khera Road, Khurja – 203 131, Uttar Pradesh, India	+919412227017
8	Mr Mukesh Kumar Sharma	M/S Anupam Pottery Works, GT Road, Khurja – 203 131, Uttar Pradesh, India	+919410264650
9	Mr Maru Ashwin Kumar Kesshajibhai	Sunrise Potteryy Works Amarpar Thangadh – 363 530, Gujarat, India	+919825215642
10	Mr Mokhasana Kiritkumar Shamjibhai	Royal Ceramics, Chotila Road, Thangadh – 363 530, Gujarat, India	+919824281755
11	Mr Sompura Dushyant Sureshchandra	Ariston Ceramics, Tranetar Road Thangadh – 363 530, Gujarat, India	+919825077447
12	Mr Karsanbhai Premjibhai Vadavia	M/s Sonex Ceramics, 8 A, National Highway, Lalpar, Morbi – 363 642, Gujarat, India	+919825583853
13	Mr Sudhirbhai Balubhai Patel	M/s Face Ceramics Ltd 8 A, National Highway, Lakhdhirpur	+919825222823

		Road, Morbi – 363 641, Gujarat, India	
14	Mr Dilip Ratilal Adroja	M/s Metro Ceramics 8 A, National Highway Lakhdhirpur Road, Morbi – 363 641, Gujarat, India	+91 9825231136
15	Mr Gautam Ashokbhai Khant	M/s Galaxy Sanitarywares Private Ltd, 8 A, National Highway, Matel Road, Dhuva –363 622, Gujarat, India	+919827213990
16	Mr Lalit Kumar Sharma	Scientist incharge, CGCRI Khurja – 203 131, Uttar Pradesh, India	+919810044600
17	Mr Satyendra Nath Misra	Scientist in charge, CGCRI, Naroda Centre, Ahmedabad, Gujarat, India	+919427624352
18	Mr Sanjeev Kumar	Group Manager, National Council for Cement and Building Materials, Ballabgarh, Haryana, India	+919891989540
19	Mr Bhogaraju Brahmaji Rao	C/o Morbi Dhuva Glaze Tiles Association Morbi, Gujarat, India	+91825440645
20	Mr Khachar Digpal Ramkubhai	C/o Federation of Ceramic Association, Thangadh, Gujarat, India	+919879507744
21	Mr Shakeel Ahmed Khan	Secretary, Khurja Pottery Manufacturers Association, Industrial Estate GT Road, Khurja – 203 131, Uttar Pradesh, India	+919837094402

Annexure 3

List of units visited by international experts (March 2008)

Morbi
M/s Sonex Ceramics
M/s Galaxy Sanitary wares
M/s Face Ceramics and Metro ceramics

Thangadh
M/s Ariston Ceramics
M/s Sunrise Pottery
Royal Ceramics

Khurja
M/s Naresh Potteries
M/s Shiv Potteries
M/s Silico and Chemico Porcelain Works
M/s Gulati Ceramics
M/s Daya Ceramics
M/s Pratap ceramics
M/s Vineet Decorators

Annexure 4

Units participating at International Exhibition: Coverings 2008, Orlando, Florida

1. Face Ceramics, Morbi: The representative already has valid visa for USA

2. Name of unit: Metro Ceramic
   Address: 8-A National Highway,
   Laghdhirpur Road, Morbi – 363 642
   Gujarat, India
   Telephone: +91 2822 243889
   Fax: +91 2822 243890
   Mobile: +91 98250 31136
   Name of representative: Adroja Dilip Datilal
   Name of father: Adroja Ratilal Laljibhai
   Designation: Partner
   Passport number: F6824561
   Date: 6 March 2006
   Validity: 5 March 2016
   Place of issue: Ahmedabad
   Email: <dilipadroja@yahoo.com>

3. Name of Unit: Sonex Ceramic, Morbi
   Address: 8A-National Highway, Lalpar, Morbi – 363 462
   Gujarat, India
   Telephone: 02822-240309
   Fax: 02822-240799
   a) Name of representative: Mr Vadaviya Karshan Premji
      Name of father: Vadaviya Premjibhai Mohanbhai
      Designation: Partner
      Passport number: A-5852432
      Validity: 28 July 2018
      Place of issue: Ahmedabad
      Email: <info@sonexceramics.com>

   b) Name of representative: Mr Vadaviya Ajay Kantilal
      Name of father: Vadaviya Kantilal Premjibhai
      Designation: Partner
      Passport number: G-0732520
      Validity: 26 November 2016
      Place of issue: Ahmedabad
      Email: <info@sonexceramics.com>

4. Name of unit: Galaxy Sanitary Wares Pvt. Ltd
   Address: 8A National Highway,
   Dhuva, Taluka-Wankaner
   Dist-Rajkot, Gujarat, India
   Telephone: 02828-287706
   Fax: 02822-231525

   a) Name of representative: Mr Khant Gautam Ashokbhai
      Name of father: Khant Ashokbhai Gopaldas
      Designation: Director
      Passport number: G-5351283
      Validity: 24 October 2017
      Place of issue: Ahmedabad
      Email: <galaxysanity@gmail.com>

   b) Name of representative: Bopaliya Chunilal Dhanjibhai
      Name of father: Bopaliya Dhanjibhai Ambabhai
      Designation: Quality Control Manager
      Passport number: E-6747044
      Validity: 25 September 2013
      Place of issue: Ahmedabad
      Email: <galaxysanity@gmail.com>

Additional units

5. Name of unit: Atlas Industries
   Address: 8-A National Highway,
   Lalpar, Morbi – 363642
   Gujarat, India
   Telephone: +91 2822 240574
   Fax: +91 2822 240741
   Mobile: +91 98251 09130
   Name of representative: Vachhani Rajesh Dayalal
   Name of father: Vachhani Dayalal Arjanbhai
   Designation: Technical Advisor
   Passport number: E1689553
   Date: 25 May 2002
   Validity: 26 May 2012
   Place of issue: Ahmedabad
   Email: <rajdvachhani@rediffmail.com>; <rajdvachhani@hotmail.com>

6. Name of unit: Salon Ceramic Pvt. Ltd
   Address: Old Ghuntu Road,
   8-A, National Highway, Morbi – 363 642

Gujarat, India
Telephone: +91-02822-242115
Fax: +91-02822-242116
Mobile: +91 98250 43957
Name of representative: Hitesh Amarshibhai Loriya
Name of father: Amarshibhai Valjibhai Loriya
Designation: Marketing Manager
Passport number: G 7291665
Date: 29 February 2008
Validity: 28 February 2018
Place of issue: Ahmedabad
Email: <salonceramics@yahoo.com>; <hiteshloriya@yahoo.co.in>
Website: <www.salonceramic.com>

7. Name of unit: Sanyo Ceramic, Morbi
Address: 8-A, National Highway, Lalpar, Morbi – 363 642
Gujarat, India
Telephone: 02822-241994
Fax: 02822-243494
Name of representative: Mr Upendra Ramshibhai Nagar
Name of father: Nagar Ramshibhai Rajabhai
Designation: Marketing Manager
Passport number: E-2223416
Validity: 11 June 2012
Place of issue: Ahmedabad
Email: <info@sanyoceramics.com>

Annexure 5

List of units selected for conducting energy audits and demonstration of energy efficient technologies

Sl No	Unit	Technology	Product
Khurja cluster			
1	**Anupam Pottery**	DD Kiln	Electric insulators
2	**Daya Ceramic**	Tunnel kiln	Crockery
3	**Gulati Ceramic**	Tunnel kiln	Bone china
4	**Naresh Potteries**	Tunnel kiln	Electric insulators
5	**Pratap Ceramics**	Shuttle kiln	Artware
6	**Shiv Potteries**	Tunnel kiln	Crockery
7	**Silico and Chemico**	Shuttle kiln	Scientific instruments
8	**Vineet Decorators**	Tunnel kiln	Tableware
Morbi cluster			
9	**Face Ceramics**	Roller kiln	Wall tiles
10	**Galaxy Sanitary Ware**	Tunnel kiln	Sanitary wares
11	**Metro Ceramic**	Roller kiln	Tiles
12	**Sonex Sanitary**	Tunnel kiln	Sanitary wares
Thangadh cluster			
13	**Ariston Ceramics**	Tunnel kiln	Sanitary wares
14	**Sunrise Potteries**	Tunnel kiln	Sanitary wares
15	**Royal Ceramics**	Tunnel kiln	Insulators

Annexure 6

Questionnaire for diagnostic study on ceramics manufacturing units

Name of the unit				
Address (telephone/fax/email)				
Contact person (designation: proprietor/manager)				
Products being manufactured				
Markets where the products are sold (places) and costs by product in each market Modalities: retail/dealership chain/exclusive stores/big clients (name/location and % age share of production in each)				
Production (by product)/month and costs per unit produced				
Raw materials being used: Source (place it is procured from) and cost per unit. Indicate main providers: name/location, by raw material.				
Type of process being used to convert raw materials to finished goods. (If non-standard, draw flowchart at Annexure I) (including heat treatment and finishing)				
Type of kilns (shuttle/tunnel/other)				
Kiln parameters: Size (length/width/height [total and working])/zones (numbers and temperature in each – Thermocouples (existing/working) – Y/N Energy: oil/gas/coal/electricity/other Estimated quantity of energy used/ton of production (Specific Energy Consumption [SEC]) Burner system: mono block/automatic controls/standard make/locally designed/numbers and placement Kiln furniture: Saggers/decker plates/trolley-kiln cars/others – numbers. Insulation of Kiln cars (refractory/bricks/ceramics) Decker plate (refractory/Cordierite) Furniture weight inside/outside kiln				
Cost of manufacturing per tonne of produce (by product)	Material	Energy	Labour	Others
Any value engineering to reduce costs: innovative strategy				

Safety and environment (awareness levels): audits/certifications/mandatory requirements (PCB/factory inspector and so on) Waste streams (air/water/land): management General housekeeping: satisfactory/needs improvement	
Quality management (awareness levels: audits/certifications)	
Indicate, by stage: raws/process/finished product	
Procedures/practices (visual/craftsman experience/scientific)	
Management structure (organogram numbers): craftsmen, skilled workers, labour (mother/father/children)	
Available skills/training programmes attended/capacity building required (indicate areas)	
Service providers: maintenance, contactors, energy auditors, and so on Service provided/names of firms/individuals.	
Specific support/assistance being provided by agencies (SSI's/CGCRI/NCB/EEPC and so on), by agency	
Required support and suggestions	
Member of association(s)	
Support/assistance provided and required: suggestions	
Factors that can provide competitive advantage: identify constraints	
Suggestions on removal of constraints	
Suggestions/comments on project deliverables	

Note: Use extra sheet for Annexure 1/organogram/other details.

Annexure 7

List of service providers

Khurja

1. M/s Karim Kiln Manufacturer
2. M/s Khurja Refractory Centre
3. M/s Rosy Engineering Works
4. M/s Khurja Engineering Works

Thangadh

A) Film burners and automation

1. Encon Thermal Engineers (P) Ltd
   105, Elite House, Kailash Colony
   Community Centre, New Delhi – 110 048
   Telephone: 26439324

2. Riellos P A
   ViadegliAlpini, 1
   37045 Legnago (VR)
   Italy

3. Burmax India
   338, Balmukund Road, Giri Nagar
   Kalkaji, New Delhi – 110 019
   Telephone: 011 2621 1772

4. Faber Burner Company
   1000, East Bald Eagle Street
   Lock Haven PA17745
   Email: <sales@faberburner.com>

5. John Zink Asia-Pacific
   7th Floor, KSS Gotanda Building
   21-8, Gotanda 1 Chrome
   Shingakawa-ku, Tokyo – 141-8538, Japan
   Email: <info@johjzink.com>

B) Ceramic fibre insulation

1. Murugappa Morgan Thermal Insulation
   A-71, 7th Floor, Himalaya House
   23, KG Marg, New Delhi – 110 001

2. Minwool Rock Fibres
   204, Kings Apartments
   Juhu Tara Road, Juhu
   Mumbai – 400 049
   Telephone: 022 2615 4809

C) Advanced branded kilns

1. Sacmi Impianti India
   3, Ratnam Square, 3rd Floor
   Plot No 38 and 39 – Sector 19/A
   Vashi – Navi Mumbai – 400 705
   Telephone: 22 67901533/34
   Fax: 22 6790 1535
   Email: <sacmimum@bom5.vsnl.net.in>

2. Tung Chung Kiln Mechanical Co. Ltd
   No 2 Dongfang Industrial District
   Songgang Town, Shenzhen City
   Guangdong Province
   China 518 105
   Telephone: 86 755 27096059-60
   86 13823780775/86 755 27093672
   Email: <www.tckiln.com>

D) Low weight kiln furniture

1. Saint Gobain, Bengaluru

2. Carboundum Universal Ltd
   Parry House, 6th Floor
   43, Moore Street
   Chennai – 600 001
   Telephone: 044 2530 6789
   Fax: 044 2535 8176
   Email: <www.cumi.murugappa.com>

E) Flue gas analysers

1. Forbes Marshall
   PB No 29, Mumbai–Pune Road
   Kasarwadi, Pune – 411 034
   Telephone: 0212 2127 9445
   Email: <www.forbesmarshall.com>

2. Nevco Engineers (P)Ltd
   90A, Amritpuri B, Main Road
   East of Kailash
   New Delhi – 110 065
   Telephone: 26226328

3. Marvel Engineering Co. Ltd
   28, Deivasigamani Road
   Royapettah
   Chennai – 600 014
   Telephone: 044 2811 0582

F) Instruments (manometers/temperature indicators, and so on.)

1. AN Instruments
   59 B, Chowringhee Road
   Kolkata – 700 020
   Telephone: 030 2240 2222

2. Chemtrols Engg Ltd
   Amar Hill, Saki Vihar Road
   Powai, Mumbai – 400 072
   Telephone: 022 2857 5089
   Email: www.chemtrols.com

G) Process indicator or controllers

1. Microedge Electronics Pvt. Ltd
   255, II Main Road, Nehru Nagar
   Kottivakkam, Chennai – 600 096
   Telephone: 044 2448 1415, 2448 1424
   Email: aciss@vsnl.com

H) Energy-saving products

1. Gautam Enterprises
   205, Vinay Industrial Estate
   Chincholi Bunder Link Road
   Malad (W), Mumbai – 400 064
   Telephone: 022 28750422, 56054646
   Fax: 022 28736985
   Email: gautamnet@vsnl.net

Annexure 8

Project completion report

on

Demonstration of Fast Firing Technology

Sponsored by

United Nations Industrial Development Organization

(UNIDO), New Delhi

Central Glass and Ceramic Research Institute

Khurja Centre

GT Road, Khurja – 203 131, Uttar Pradesh

Phone: (05738-232501) Fax (05738-245081)

March 2008

1. Introduction

With the progress of civilization, the demand of ceramic articles is growing up. It has contributed substantially towards health and sanitation through use of sanitary wares, tiles and crockery wares. Ceramics also play a dominant role in distribution of electricity all around the world by using LT and HT insulators, fuse bushes, kit-kat and so on, chemical porcelain helps in R&D laboratory and chemical industry in a significant way. Electronic ceramic have very important properties like resistance to high heat and abrasion with load bearing capacity. In this way, ceramic is a very important material.

To meet the requirement of people, Khurja pottery industry is playing a great role in India and abroad where more than 500 ceramic industries have been producing different articles. The history of Khurja pottery goes back to ~600 years ago, when some of the potter's families moved from Delhi to Khurja during the reign of Mohammad-bin-Tuglak. Khurja is known as an oldest pottery clusters in the country and engaged in the manufacturing of variety of ceramic articles like decorative crockery wares, flower vases, planters, bone china wares. HT and LT insulators, sanitary wares designed tiles, grinding wheels, kit-kat, electrical and domestic articles. Due to globalization of market, the Khurja pottery clusters needs to work for up-gradation in the level of technology, operation practices, cost reduction, energy saving, waste utilization and quality improvement.

In view to up-grade the technology of manufacturing with the reduction in energy consumption by using eco-friendly fuel, reduction in wastage and cost of production with improvement in the quality, CGCRI, Khurja Centre undertaken a project on "Development and Setting up of a Gas Fired Roller Hearth Kiln" under ASIDE Scheme sponsored by UPSIDC, Kanpur. Under this project a modern gas fired roller hearth kiln was set up to study the benefit for the pottery industries.

To optimize the firing process and schedule, some firing trials were required for which CGCRI, Khurja Centre consulted Mr Upendra Malik, representative of UNIDO, New Delhi for financial support. Finally a project on "Demonstration of Fast Firing Technology" was sponsored by UNIDO to CGCRI, Khurja Centre.

2. Objective

To develop fast fired stoneware composition for gas fired roller hearth kiln.

3. Details of the project

- Submission of the project proposal: 12 January 2006
- Approval of the project: 2 March 2006
- Total grant: `0.1924 million
- Duration of the project: 12 Months
- Extension period: Up to April 2007

The work was started as per main objectives. We reached on our goal due to remarkable suggestions by Dr H S Maiti, Director, CGCRI, Dr L K Sharma, Scientist-in-Charge, CGCRI, Khurja Centre and Mr Upendra Malik, Project Coordinator, UNIDO, New Delhi. The following steps were taken up to complete the work.

(i) Collection of traditional stoneware body mix and unfired products
(ii) Development of fast fired ceramic composition for stoneware
(iii) Optimization and demonstration of firing
(iv) Conclusions

4. Collection of traditional ceramic green wares

Traditional stoneware composition and unfired wares were collected to study the properties in unfired stage as well as after firing in gas fired roller hearth kiln and to compare with fast fired composition.

5. Development of fast fired ceramic body

A fast fired stoneware composition was developed by using following raw materials.

- China clay
- Ball clay
- Quartz (-300 mesh)
- Potash feldspar (-250 mesh)
- Talc (-300 mesh)

The compositions prepared are given below

Table 1** Fast **fired stoneware body composition

	Traditional body	**Fast fired bodies**	
Raw materials	**A (T)**	**B (FFC)**	**C (FFC)**
China clay	7	33	33
Ball clay	43	17	17
Potash feldspar (-250 mesh)	20	23	23
Quartz (-300 mesh)	30	27	27
Talc (-300 mesh)	-	6	4

The properties of products (coffee mugs) were determined at pre-fired and fired stages (Tables 2 and 3).

Table 2** Properties of **composition before firing

Properties	**Traditional body**	**Fast fired compositions**	
	A (T)	B (FFC)	C (FFC)
Residue on 300 # sieve	3.96	0.26	0.24
Water of plasticity (%)	27.6	26.4	26.2
Dry linear shrinkage (%)	5.86	4.36	4.42
Dry MOR (kg/cm^2)	21.0	17.00	17.00

Table 3 ***Particle size distribution of composition (mixes)***

Particle (in micron)	A (T)	B (FFC)	C (FFC)
Coarser than 25	34.0	5.0	3.0
Between 25 and 15	10.0	11.0	12.0
Between 15 and 10	6.0	10.0	10.0
Between 10 and 8	2.0	5.0	5.0
Between 8 and 5	4.0	12.0	7.0
Between 5 and 3	7.0	9.0	10.0
Between 3 and 2	6.0	4.0	6.0
Between 2 and 1	7.0	8.0	9.0
Below 1	26.0	36.0	38.0
Below 10	51.0	74.0	75.0
Below 15	58.0	84.0	85.0

6. Optimization and demonstration of firing

For optimization of firing schedule and demonstration of firing in gas fired roller hearth kiln, large number of mugs were collected from units and fired in gas fired roller hearth kiln with demonstration to the entrepreneurs of Khurja. The firing results were analysed to know the fuel consumption and reduction in the rejection. In the same process, wares made from developed fast fired composition were also fired. Firing results were analysed. Firing was done at 1200°C for different firing periods (cool to cool) e.g. 270, 240, 210, and 180 minutes. All the results are given in Tables 4–8 and the oil consumption for the firing in traditional tunnel kilns are shown in Table 9.

Figure 1 Gas fired roller hearth kiln

Figure 2 Students from college looking the final products fired in gas fired roller hearth kiln

Table 4 ***Water absorption of products (coffee mugs) fired in gas fired roller hearth kiln***

Firing Cycle	Time (in minutes)	A (T)	B (FFC)	C (FFC)
1	270	3.76	1.66	0.10
2	240	4.64	2.92	0.16
3	210	5.24	3.84	0.86
4	180	5.38	4.36	1.42
5	180	5.66	4.36	1.40

Table 5 ***Bulk density of products (coffee mugs) fired in gas fired roller hearth kiln***

Firing cycle	Time (in minutes)	A (T)	B (FFC)	C (FFC)
1	270	2.27	2.31	2.37
2	240	2.27	2.30	2.37
3	210	2.25	2.29	2.36
4	180	2.24	2.28	2.35
5	180	2.24	2.28	2.35

Table 6 ***Linear thermal expansion of the samples (unglazed) fired for 210 minutes at 1200°C***

Temperatures	A (T)	B (FFC)	C (FFC)
100	0.064	0.0112	0.0072
200	0.110	0.0608	0.0556
300	0.166	0.1213	0.1149
400	0.230	0.1886	0.1816
500	0.312	0.2636	0.2573
600	0.428	0.3507	0.3474

Table 7 ***Fired rejection level in different firing schedule***

Time (in minutes)	A (T)	B (FFC)	C (FFC)
270	16.6	9.8	5.8
240	18.5	10.6	6.4
210	20.3	10.8	7.2
180	22.8	13.4	6.9
180	22.8	N.A.	7.8

Table 8 ***Details of firing in gas fired roller hearth kiln***

Firing number	Firing time (minutes)	Weight of green product	Wt. of fired product	Gas consumed kg/kg	Energy consumed kcal/kg
1	270	1008	891	0.520	6,136
2	240	1025	906	0.490	5,782
3	210	1752	1537	0.320	3,776
4	180	1600	1400	0.321	3,788
5	180	1800	1580	0.284	3,351

Table 9 ***Details of oil consumption in oil fired tunnel kiln***

Serial number	Name of unit	Fuel consumption, HSD (litre/24 hours)	Weight of fired product (kg/24 hours)	Fuel consumption (litre/kg product)	Energy consumed kcal/kg
1	M/s Dadoo Pottery	600	2801	0.214	2,311
2	M/s Chhatwal Ceramic	768	6194	0.124	1,265
3	M/s New Adarsh Pottery	580	3719	0.156	1,591
4	M/s Dharma Seva Samiti	540	4100	0.132	1,346
5	M/s Alimuddin Pottery Works	650	5125	0.127	1,295

Dissemination of technology through workshop

The developed technology was disseminated through conducting a workshop on "Development of Fast Fired Body through Firing in Gas Fired Roller Hearth Kiln" on 27 August 2008. About 43 potters participated in the programme. All the participants appreciated the work and discussed about the developed technology.

Mr Yad Ram, Technical Officer delivering a lecture during the workshop

(7)

Table 10 : Reason of Rejection of Stoneware Products Fired in Roller Hearth Kiln in 180 mins. (cool to cool)

S. No.	Reason of Rejection	TB (A)	TB (B)	TB (C)	FFB (D)
1	Cracks after firing (dunting)	8.66	8.47	5.09	2.62
2	Pin holes	5.92	5.79	3.48	1.79
3	Crawling	3.64	3.56	2.14	1.10
4	Warpage	2.05	2.00	1.20	0.62
5	Green Cracks in preheating	1.59	1.56	0.93	0.48
6	Others on handling	0.91	0.89	0.53	0.27
	Total	22.77	22.27	13.37	6.88

* TB – Traditional Body

8. Conclusions:

1. Addition of 4% Talc was found suitable to meet standard BIS specifications of the products. (As per BIS water absorption should be less than 3 %)
2. Fast fired Stoneware composition C (FFC) had lowest fired rejections in comparison to traditional Stone ware compositions.
3. There was increase in fired rejection of the fast fired body composition C (FFC) with the reduced firing period (cool to cool) from 4.5 hours to 3.5 hours. further reduction of firing period to 3 hours gave marginal reduction in rejection but on repetition it went up. Therefore, we can conclude that 3.5 hours firing cycle is suitable for fast firing technology based on indigenous raw materials. Still there is scope that properties may further improve with the change in raw materials.
4. There was almost no change in the consumption of LPG, when firing period was reduced from 3.5 hours to 3 hours. Increased water absorption of the products in 3 hours firing period also justified that 3.5 hours cycle is better. Confirmation firing cycle of 3 hours (No.5) although showed lower gas consumption but rejections went up. Therefore, 3 hours cycle is not suitable economically.
5. The length of the roller hearth kiln is of pilot scale i.e. 90 feet. If kiln is constructed at commercial scale by increasing the length, the fuel consumption will be reduced.
6. The main objective of the project was to developed fast fired body which was achieved with the firing of products within 4 hrs.
7. The rejection in traditional bodies was found from 13.77 to 22.37 whereas rejection was found below 6.27% with the firing within 4 hrs. Hence developed body is most suitable for fast firing system.
8. Trials of firing was taken in single deck system. If firing is done in double deck system the fuel consumption will be reduced by 50%.
9. The trial of firing was done periodically hence energy consumption was higher side. Energy consumption may be reduced if kiln will be operated continuously.
10. The firing results showed that the energy consumption can be reduced below 1000 K. Cal /Kg.

24/9/08 24/9/08

Yad Ram	Dr. C. S. Prasad	Dr. L. K. Sharma
Technical Officer	Technical Officer	Scientist-in-Charge

Findings: CSR Study

Scoping socially responsible behaviour in SMEs: Case study number 1: Thangadh

Overview

Location: Thangadh is 160 km from Ahmedabad. It is an industrial town and a municipality located South West of Surendranagar, in Surendranagar district, in Gujarat.

Number of units: 134 (as per Federation of Ceramic Industries List 2009)

Core products and processes: Sanitary ware and ceramic floor and wall tiles. Tunnel kilns were used for sanitary ware and ceramic tiles were baked on roller kilns.

Average annual turnover: INR 20–70 million (for the sampled enterprises)

Market: The units market their products all over the country and some of them export their products overseas (China, Italy, Middle East, African countries, Sri Lanka, Bangladesh, and so on) either directly or through agents.

Key support institutions located in the cluster/region: Central Glass and Ceramic Research Institute (CGCRI), Ahmedabad; Panchal Ceramic Association; Federation of Ceramic Association; and Small Industries Services Institute (SISI)

Ownership structure: Majority (90%) of the enterprises are partnership based. All these units are close knit and are managed by family/close friends. Each member concentrates on one area such as marketing, production, and finance and they have the acumen to manage and run the units.

Employment structure: The medium-sized sanitary ware units have 15–20 skilled and semi-skilled workers. A large number of workers are migrants from Rajasthan, Orissa, Bihar, Uttar Pradesh, and the neighbouring cities of Thangadh. The issue of child labour does not exist. Majority of the workers in these units are 25–35 years, with a male-female ratio of 3:1. The attrition rate is low in this cluster and, on an average, the workers work for 4–5 years in a unit.

On an average, each worker's family has 3–4 members and 67% have more than one earning member. Workers, in general, stay close to the units and commute to work by walking or riding a bicycle. About 25% use two-wheelers or rickshaws and 13% spend less than `500 a month on commutation.

Management structure: Majority of owners said they imbibe good social practices in their day-to-day work without necessarily having a written corporate social responsibility (CSR) policy. Further, due to the compact size of operations, the owners are directly involved in implementing social and environment standards in the units. This also facilitated direct communication between enterprise owners and workers.

Contractual structure: The unit owners are directly involved with recruitment and management of workers, thus eliminating the role of contractors. However, for certain activities like packaging and transportation, private contractors were hired by some organizations.

ICT adoption: About 97% units have access to basic communication (fixed lines/mobiles/phones/faxes) and 87% use basic information technology (IT) (personal computers [PC] equipped with basic software and hardware) in their day-to-day business operations.

Workplace practices

Certifications

A majority of the units have ISO/ISI certification for the plant/product and the export oriented units have adopted BVQI and CAPXIL certificates. All units have clearance from the Pollution Control Board.

Documentation

Almost all units maintain attendance records and 38% and 61% maintain working contracts and copy of ID card of the workers, respectively. About 77% have records of accidents and injuries. In addition, 90% of the workers surveyed receive pay slips.

Compensation data

On an average, an employee works for 8–10 hours daily with an hour's break and a weekly off. Workers were also offered leaves on statutory holidays, religious observations, and personal emergencies.

Interestingly, it was noted that the skill-based workers receive more than the minimum salary laid down by the government under the Minimum Wages Act. Further, no incidence of sexual harassment or deviation in compensation/benefits, based on gender, religion, caste, race, age, disability or health status was reported.

Occupational health, safety, and social facilities

Over 90% of the workers stated that they have access to clean potable drinking water and toilet convenience facilities in the work premises. About 87% stated that personal protective equipments were provided to them; however, usage and enforcement of the same was low. Further, in almost all units (97%), early fire warning systems have been installed and safety instructions provided. Moreover, emergency escape routes have been clearly marked in 61% of the units.

In 83% of the units, at least one employee had been trained to provide first-aid; and during times of emergency, the unit owner provides his own vehicle for taking workers to the hospital.

Almost all women (lactating) said that they did receive timely medical help and financial support from their employers. However, no clear response was received on the issue of maternity leave. About 70% of the workers receive ESI facility and are entitled to provident fund.

Environment policies: Due to the nature of operations and materials being used, environmental practices were well developed in the cluster. Interestingly, majority of the units are using water and waste management techniques and energy conservation measures. Unit owners showed enthusiasm in learning about new environmental best practices. The cluster has a vibrant cluster association, which is both active and influential to ensure that the balance is being maintained between the workers and the enterprise owners.

Key social and community initiatives of the cluster:

- Owners and workers share cordial relations and owners ensure that workers are supported financially in times of need (payment of education fee/medical treatment/marriages).
- Construction and operation of primary school for the children of the factory workers.
- A girl's hostel facility has been established at Chotila-Limdi Highway Road, wherein 400 girls from low-income families receive free education.
- Enterprises, at their individual level, take up initiatives such as setting up schools, medical facilities, and animal shelters. However, able leadership within the association and interactions with civil societies ensures that other enterprises also pitch in with resources to strengthen the institutions of common services.
- Organizing community get-togethers for workers' families during Deepawali, Ganesh Chaturthi, Vishwakarma puja, and other festivals.
- Construction of a 30-bedded general hospital, which has been donated to the local authorities to be run under public–private partnership (PPP) model.
- Financial support to "Kanya Kelavani" (educating the girl child): a programme of the Gujarat government.

- Tree plantation and mending water works.
- Construction of local roads to facilitate transportation.
- At times, when trains have been stranded at Thangadh station, enterprise owners have provided food and water to travellers.
- Provided immediate support during Gujarat earthquake; volunteering to provide food items and support rehabilitation work.

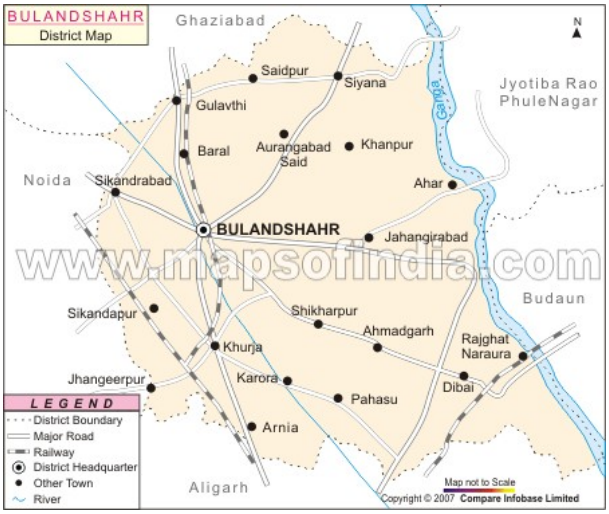
Scoping socially responsible behaviour in SMEs: Case study number 2: Khurja

Overview

Location: Khurja is located in Bulandshehar, Uttar Pradesh, India. It is situated around 85 km from Delhi.

Number of units: 494 (as per CGCRI list)

Core products: High tension (HT) and low tension (LT) insulators, bone china and stoneware crockery, high voltage (HV) and low voltage (LV) transformer bushings, disc pins and post insulators, tableware, khullars (earthen tea cups), laboratory items, hand-made ceramic tiles, fancy items, art wares, and so on.



Average annual turnover: Enterprises in Khurja are promoted as "Laghu Udyog" (cottage industry). The typical enterprise turnover for the sampled enterprise ranges between INR 5–10 millions.

Market: About 70% of enterprises supplied material for domestic needs, whereas 27% cater to both domestic and export markets. The Government of India has identified Khurja ceramic cluster as the growth centre for exports.

Key support institutions located in the cluster/region: Khurja Potteries Manufacturers Association (KPMA), Uttar Pradesh, and Central Glass and Ceramic Research Institute (CGCRI), Uttar Pradesh.

Ownership structure: About 97% of the 30 enterprises surveyed are partnership based. Partnerships were usually among family members.

Employment structure: Khurja relies largely on agricultural labourers living in towns and villages in the vicinity. Few workers are immigrants from the states of Bihar and eastern Uttar Pradesh in search of better employment opportunities.

The workers' ages vary between 20 years and 55 years, with a majority being 32-35 years. Due to the involvement of the local association (KPMA), child labour does not exist. Skill distinction among workers forms the basis of wage structure in the units. However, minimum statutory wages are paid to unskilled labourers.

Management structure: The management of an enterprise, in 90% of the units, is under the care of the unit owner and his family members. Due to direct involvement of family members in the operations, it is easier for workers to directly communicate with the management on their social and workplace-related needs.

Contractual structure: Due to the small size of operations, few contractors were hired, mainly for kiln and ball mill maintenance and painting of potteries.

ICT adoption: The enterprises show a progressive trend in terms of ICT adoption. Almost all units have some form of basic communication system including mobile phones, internet, and emails. However, the cluster is lacking in adoption of advanced IT facilities, such as automated resource management systems and account management systems.

Workplace practices:

Certification

About 30% of the enterprises surveyed have obtained voluntary certifications such as ISO 9001 and ISO 9008. The chief reason for the same was process improvement and value addition to the quality. ISO certification is also obtained by the export-oriented units and 23% of the manufacturers that supplied goods, especially electrical goods (circuit breakers and so on), to government agencies have ISI certifications.

Documentation and compensation data

Employee related documentation along with attendance records is maintained by all enterprises interviewed. The same is also used to calculate workers' monthly wages.

Occupational health, safety, and social facilities

With regard to occupational health and safety, due to the non-hazardous nature of the industry, no accidents have been reported. Further, 77% of the enterprise owners ensured that their employees availed ESI benefits. In times of emergency, the unit owners provide their own vehicle for taking the workers to the hospital. They also provide them with financial assistance, if required. 70% of the workers said that they have received health and safety information/training during the initial days of their employment.

About 87% of the workers surveyed said that they were trained to provide first-aid in case of emergency situations. KPMA association representatives are responsible for awareness programmes with the local authorities such as the fire department, health melas, and blood donation camps.

Key social and community initiatives of the cluster:

- Donations and philanthropic activities were carried out by most of the enterprises.

- Enterprises take up initiatives such as setting up schools, medical facilities, and animal shelters. Able leadership within the association facilitates pitching of resources by the member units to strengthen institutions of common services.
- Provide relief and rehabilitation to the affected during Kosi floods with food items, medicines, and other essential items.
- Unit owners provide workers with financial assistance as and when required.

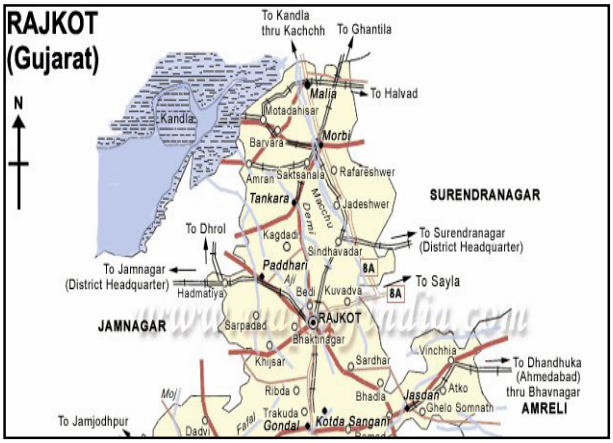
Scoping socially responsible behaviour in SMEs: Case study number 3: Morbi

Overview

Location: Morbi is 210 km from Ahmedabad and about 65 km from Rajkot. Morbi is located in proximity to Navlakhi port (45 km), which gives it an advantage to export.

Number of units: Around 400
Core products and processes: The main items produced by the cluster are floor and wall tiles and sanitary ware.

The types of kilns operational in Morbi are generally tunnel kilns for sanitary ware and roller kilns for ceramic tiles. The roller kilns used for the manufacture of tiles have computer based firing control and the temperature profile is preset. The tunnel kilns have manual control. Some of the units have timer-based alarm for kiln car movement.



Avg. annual turnover: `30–70 million (for the sampled enterprises) The sector showed 15% enterprise growth rate and the exports for 2007 averaged to 15%.

Market: The units market their products all over the country and some of them export overseas (China, Italy, Middle East, African countries, Sri Lanka, Bangladesh, and so on) either directly or through agents.

Key support institutions located in the cluster/region: CGCRI, Ahmedabad; Morbi Sanitary Wares Manufacturers Association; Morbi Dhuva Glaze Tiles Association.

Ownership structure: Majority (75%) of the enterprises surveyed is partnership-based. 11% of the units surveyed are single-ownership based and an equal proportion (11%) are private enterprises. All these units are close knit and are managed by family/close friends.

Employment structure: The larger units have more than 100 workers and supporting staff. The medium sanitary ware units have 15–20 skilled and semi skilled workers. The cluster has a large number of migrant population hailing from neighbouring states of Rajasthan and Madhya Pradesh (approximately 42%) as contract workers and majority of them are unskilled (only 11% skilled). The issue of child labour is non-existent.

On an average, each worker's family has 3–4 members, in which there is more than one earning member. Majority (71%) of the workers commute to work by walking as they live nearby or in company quarters whereas the 29% who do not have access to quarters have to spend almost 10-20% of their income on transportation.

Management structure: Majority (90%) of the enterprises surveyed have a "Company Policy for CSR and Environment" but there was no written stated policy available. Further, only 1/3 of the enterprise owner surveyed have senior management representatives responsible for ensuring social and environment standards within the enterprise. Moreover, given that the contractors are not part of the management structure, it is possible that the contractors are not fully aware of the corporate social responsibility (CSR) practices of the enterprises. However, the adoption of codes and standards within the cluster was encouraging based on the survey results.

Contractual structure: There is no established procedure to hire contractors. But majority (60%) of the contractors affirmed that they received rewards and acknowledgement for socially responsible behaviour. However, no record keeping of workers with the contractors was observed.

ICT adoption: Almost all units have access to basic communications (fixed lines/mobiles/phones/faxes) and use basic information technology (IT) (personal computer [PC] equipped with basic software and hardware) in their day-to-day business operations.

Workplace practices

Certifications

Majority of the units have ISO/ISI certification for the plant/product. All units have clearance from the Pollution Control Board.

Documentation

Attendance is very well maintained as it suits the entrepreneur to keep a record of it. However, there is laxity in maintaining pay slips and health-related documentation. Wage payment is still without the pay slip and across counters.

Compensation data

On an average, work day lasts for 8–10 hours. Workers avail leaves during statutory holidays, religious festivals and personal emergencies. Due to the operational structure of the units overtime was not encouraged.

Average wages received by the workers is above the average wages paid in other states and are as per the state rules. One of the defining features of the cluster which the survey identified was that the incomes of the workers were not discriminated on the grounds of cast, religion or language.

Occupational health, safety, and social facilities

Access to clean potable drinking water and toilet convenience facilities for the workers was provided in the work premises. However, very few units have processes in place to identify risks for health and safety of the workers. It was noted that personal protective equipment was provided to the workers; however, usage and enforcement of the same is low. Further, in almost all units, early fire warning system and safety instructions had been installed and emergency escape routes had been clearly marked. However, the units need to improve in housekeeping to provide good working environment for workers and bringing down accident rates. At least one employee in the unit has been trained to provide first-aid; and during times of emergency, the unit owner provides his own vehicle for taking workers to the hospital.

On the water and sanitation front, the cluster units scored high as all the workers participating in the survey informed that potable water was available within the premises and on an average, two to three toilets for men and women are allotted and are kept clean.

On the issue of social and health benefits, majority of the women do not receive maternity benefits and there are no signs of any health or pension covers for the worker and the family. No clear response was received on the issue of maternity leave. However, it was noted that workers received necessary treatment and support in times of need from the owners.

There was a marked variation in the responses of the contractors and the enterprise owners, on the issue of workers' health and safety. This may be interpreted as the contractors' observations that the workers should be provided with more facilities and that currently, the provision for the same is inadequate.

Environment policies: Associations have fostered linkages with local R&D agencies and UNIDO to work on energy conservation measures and product development issues. The cluster is also aware of waste management practices and takes measures for reuse of waste products. From the interactions with the enterprise owners, it was evident that they were keen to learn ways and means to reduce their environmental footprints through better and improved technologies and processes. They understood how these efforts would be helpful for the long-term sustainability of their businesses.

The cluster has a vibrant cluster association, which was both active and influential to ensure that the balance is being maintained between the workers and the enterprise owners.

Key social and community initiatives of the cluster:

- Majority of the owners said they provide financial support to the workers and villagers in times of need.

- Individual units arrange public gatherings at times of festivals and also encourage workers to participate in health melas, langars.
- Provided immediate support during Gujarat earthquake; food items and supporting rehabilitation work as volunteers.
- Association also facilitates interactions among the cluster members on issues related to new technologies, production process improvement, taxation, market opportunities, and so on.

Annexure 10

Feedback of industry associations on CSR study report

President
SURESHBHAI P. SOMPURA
Mo. 98252 18177

FEDERATION OF CERAMIC INDUSTRIES

OFFICE : C/o. ANCHOR SANITARYWARE PVT. LTD.
R.P. Sompura Road, Dholeshwar Plot P. O. Box No.44,
THANGADH - 363 530. (Guj.)
Ph.: +91-02751 - 222146 / 220592

Annapurna Vancheswaran
Director, Sustainable Development Division
The Energy and Resources Institute
Lodhi Road
New Delhi -91

Dear Ms. Vancheswaran

We the members of (Panchal Ceramic Association and Federation of Ceramic Association) have reviewed the attached report prepared by The Energy and Resources Institute in collaboration with UNIDO on "Scoping Socially Responsible Behavior in the SMEs".

We would further like to bring to the attention the following:

- It is for the first time that a study "Scoping Socially Responsible Behavior in the SMEs" was undertaken in our cluster.
- From Thangadh Cluster, the TERI team interacted with 30 unit owners, workers and their families.
- The attached report does highlight the key socially responsible activities undertaken by the cluster
- The study and interactions with the TERI team has helped our member units in understanding concepts and improving their current workplace, social and environmental practices.
- Although our cluster has been carrying out various initiatives towards the betterment of the community around us, we would be happy to understand and learn more in this arena thorough handholding exercises in future by government and non- governmental organizations.

We would like to place on record that the cluster has benefited from the study undertaken by UNIDO on "National Programme to support Energy Efficiency and Quality Standards Energy Efficiency Practices" and by TERI on "Scoping Socially Responsible Behavior in the SMEs".

In future, we as a cluster will be keen to participate and learn from the global and national efforts/practices of SMEs in the field of CSR, Business Ethics and effective documentation so that we replicate them wherever possible in order to move forward in the global market.

Yours Sincerely

FEDERATION OF CERAMIC INDUSTRIES

PRESIDENT

આઈ.ટી. એક્ઝેમ્પશન સર્ટી નં.
ડી.આઈ.ટી.(ઈ)/૮૦જી/૪૨૫/૦૭-૦૮ તા. ૨૫-૩-૨૦૦૮
માન્યતા તા. ૧-૪-૨૦૦૭ થી ૩૧-૩-૨૦૧૨

ટ્રસ્ટ રજી. નં. : એફ/૨૫૬૦/સુરેન્દ્રનગર.
ફોન : (૦૨૭૫૧) ૨૨૨૪૨૮, ૨૨૦૪૨૮

પંચાલ સીરામીક એશોસીએશન વિકાસ ટ્રસ્ટ

હેડ ઓફીસ : સનરાઈઝ પોટરી વર્કસ,
અમરાપર, થાનગઢ-૩૬૩ ૫૩૦. (ગુજરાત)

પ્રમુખ : રામજીભાઈ એલ. મારૂ

રેફ નં.

તારીખ :

Annapurna Vancheswaran
Director, Sustainable Development Division
The Energy and Resources Institute
Lodhi Road
New Delhi -91

Dear Ms. Vancheswaran

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Yours Sincerely

Panchal Ceramic Association Vikas Trust

President / Trustee

Registration No. 6143/78-79 dt. 21.4.79

Telefax : (05738) 232425

KHURJA POTTERY MANUFACTURERS ASSOCIATION (Regd.)

Industrial Estate, G.T. Road, **KHURJA** 203131 (U.P.)

President	*Patron*	*Chief Patron*	*Chief Patron*	*Secretary*
Ravi Rana	**Peeyush Sharma**	**Shri Anil Sharma**	**Shri Horam Singh**	**Sanjay Gupta**
+919837027778	+919412227595	M.L.A. Khurja, Uttar Pradesh	M.L.A. Jewar, Uttar Pradesh	+919927248333 E-mail: meenapot@yahoo.com

Ref. No.: *Dated.....*

Annapurna Vancheswaran
Director, Sustainable Development Division
The Energy and Resources Institute
Lodhi Road, NEW DELHI 110 091

Dear Ms. Vancheswaran,

We the members of Khurja Pottery Manufacturers Association have reviewed the attached report prepared by The Energy and Resources Institute in collaboration with UNIDO on "Scoping Socially Responsible Behavior in the SMEs".

We would further like to bring to the attention the following:

- It is for the first time that a study "Scoping Socially Responsible Behavior in the SMEs" was undertaken in our cluster.
- From KHURJA Cluster, the TERI team interacted with 30 unit owners, workers and their families.
- The attached report does highlight the key socially responsible activities undertaken by the cluster.
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In future, we as a cluster will be keen to participate and learn from the global and national efforts/ practices of SMEs in the field of CSR, Business Ethics and effective documentation so that we replicate them wherever possible in order to move forward in the global market.

Yours Sincerely,
Sd/-
(SANJAY K. GUPTA)
Secretary
Khurja Pottery Manufacturers Association,
Industrial Estate, G. T. Road,
KHURJA

MORBI DHUVA GLAZE TILES ASSOCIATION

2-Bhagvati Chamber, 8-A, National Highway, , Morbi-2. Ph. (Fax) : 02822 - 240053
E-mail : morbiceraasso@yahoo.com

President
Becharbhai Patel - 98252 10300

Secretary
Rajubhai Patel - 98795 11609

Corporate Identity No.:
U9300GJ2007NPL051497

Manager
Ramjibhai Detroja
M. 98254 67647

Ref. No. :

Date :

Date-3/11/2010

Annapurna Vancheswaran
Director, Sustainable Development Division
The Energy and Resources Institute
Lodhi Road
New Delhi -91

Dear Ms. Vancheswaran

We the members of (Morbi-Dhuva Gleze Tiles Association) have reviewed the attached report prepared by The Energy and Resources Institute in collaboration with UNIDO on "Scoping Socially Responsible Behavior in the SMEs".

We would further like to bring to the attention the following:

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- From Thangadh Cluster, the TERI team interacted with 30 unit owners, workers and their families.
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In future, we as a cluster will be keen to participate and learn from the global and national efforts/practices of SMEs in the field of CSR, Business Ethics and effective documentation so that we replicate them wherever possible in order to move forward in the global market.

Yours Sincerely

Rajubhai Dhoodesia P.

President
(Morbi-Dhuva Gleze Tiles Association)

Annexure 11

List of units and industry representatives (interaction on energy savings)

Serial number	Unit/person
Khurja	
1	Anupam Pottery
2	Daya Ceramic
3	Gulati Ceramic
4	Naresh Potteries
5	Pratap Ceramics
6	Shiv Potteries
7	Silico and Chemico
8	Vineet Decorators
9	Mr K C Singh
Morbi	
10	Face Ceramics
11	Galaxy Sanitary Ware
12	Metro Ceramic
13	Sonex Sanitary
14	Mr C D Patel
Thangadh	
15	Ariston Ceramics
16	Sunrise Potteries
17	Royal Ceramics

Annexure 12

Letters from units on energy savings

SILICO & CHEMICO PORCELAIN WORKS
AN ISO 9001 : 2000 CERTIFIED COMPANY
C-5 INDUSTRIAL ESTATE, G. T. ROAD, KHURJA 203131 (U.P.) INDIA

Ref. No.: SIL/2010-11/60746 15/11/2010

Project Coordinator
India Ceramic Project, UNIDO
New Delhi

Subject: India Ceramic Project – Feed back

Madam,

We actively participated in various activities under the above programme and benefited. We appreciated the importance of waste heat recovery in optimizing energy efficiency. We have taken measures to recover and use waste heat for drying and preheating the products. We have added another Shuttle Kiln and through the arrangement of alternate firing recover waste heat from one kiln to preheat the war in another kiln. We also control excess air by regulating blowers. Consequently, the firing had improved with tangible results.

We have made our operations systematic and minimized wastage and have obtained ISO 9001 – 2008 Certification.

We have also made necessary arrangements to take CNG connection as soon as the supply is made available at Khurja.

Presently, we are producing, every month, about 25 MT Porcelain wares in variety of high quality scientific & laboratory wares and our monthly fuel consumption is about 10000 Ltrs.

We are keen to further enhance our capabilities through participation in similar programmes under the aegis of UNIDO.

With Regards

Yours Truly

Director
Silico & Chemico Porcelain Works
KHURJA
203131

MANUFACTURERS & EXPORTERS OF LABORATORY PORCELAINS AND INDUSTRIAL ALUMINAS

Phones : (05738) 232206, 231606 FAX : 05738-249685
E-mail : jindia25@gmail.com / sales@khurjaceramics.com / sales@silicoandchemico.com
Website : www.silicoandchemico.tradeindia.com / www.silicoandchemico.com

TIN No. 09167600325 dt. 4-1-92
C. S. T. No. KJ-5025918 dt. 9-4-92 .

Estd. 1974

I E C No. 0597028451
SSI No. 090111100683
Regd. : N. S. I. C. LTD., New Delhi

NP™ INDIA

NARESH POTTERIES

AN ISO 9001 : 2008 & 14001 : 2004 CERTIFIED COMPANY

INDUSTRIAL AREA, G. T. ROAD, KHURJA-203131 (U. P.) INDIA

Date: 22.11.2010
To:
Project Coordinator
India Ceramic Project
New Delhi

Subject: India Ceramic Project – Feed back

Madam,

We actively participated in various activities under the above programme and benefited. We appreciated the importance of waste heat recovery in optimizing energy efficiency. We have taken measures to recover and use waste heat for drying and preheating the products. We benefited with the recommendations of International experts in this regard. We now manage excess air through controlled and efficient draught system (Chimney) in the kiln. Consequently, the firing had improved with tangible results.

We have also made our operations systematic and minimized wastage. We have obtained ISO 14001.

We have also made necessary arrangements to take CNG connection as soon as the supply is made available at Khurja.

Presently, we are producing every month about 123 MT LT and HT insulators and our monthly fuel consumption is about 11,240 Ltr.

We are keen to further enhance our capabilities through participation in similar programmes under the aegis of UNIDO.

With regards

Yours truly,

Subhash Khanna

Director

MFRS. OF H. T. & L. T. PORCELAIN & POLYMER INSULATORS

Tele Fax : 91-5738-230698, 232498 *Mobile* : 0-9897011106, 0-9897011107
Website : www.indiamart.com/naresh-potteries E-mail : nareshpott@gmail.com/yahoo.co.in

From: Oswal Pottery Works <oswalpotteryworks@yahoo.in>
To: Pooja Kumar <poojak@teri.res.in>
Date: 18.11.10 09:50 AM
Subject: Re: URGENT: Request Information on Current Status of Production and Fuel Consumption in Select Units in Thangadh + Additional information

From:
M/s Royal ceramic
Thangadh, Gujarat

To:
Project Coordinator
UNIDO
India Ceramic Project
New Delhi

Dear Sir

Subject: Feedback on UNIDO Ceramic Project at Than

It my pleasure to inform you that as a result of your interventions under the above mentioned project, we have been able to achieve significant energy savings in our operations. We got access to new technology during our exposure visit to China and were able to appreciate the importance of proper drying of products before feeding into the kiln to minimize rusting and damage of kilns and also increasing the kiln efficiency. We were able to regulate excess air through monitored controls and ensure firing as per firing curve to achieve quality. Consequently, the firing has improved with tangible results. We also switched to CNG from liquid fuel as main source of energy for the kilns.
Our cluster is in the growth phase and many new units are coming up. Many activities and learnings of the project have been adopted in over 50 units in the cluster. I hope UNIDO will consider taking up similar programmes in Than in future also. We would be keen to participate in such programmes and avail the expertise and guidance of UNIDO to enhance our capabilities.

Yours truly,
KIRIT S. MOKHASANA
Director

ARISTON™
CERAMIC

Near Anchor Sanitaryware Pvt. Ltd
Tarnetar Road, Thangadh-363 530
Dist. Surendranagar (Gujarat) India
Tel / Fax : 02751- 222146

G.S.T. TIN NO.: 24080800628 Dt. 19-09-2005
C.S.T. TIN NO.: 24580800628 Dt. 19-09-2005

10 November 2010

To,
Project Coordinator
India Ceramic Project
New Delhi

Subject: India Ceramic Project – Feed back

Madam,

We actively participated in various activities under the above programme and benefited. We appreciated the importance of technology in optimizing energy efficiency. We got access to new technology and necessary assistance under the programme during our exposure visit to China. We also regulate excess air through monitored controls and ensure firing as per firing curve to achieve quality. We have improvised and made kiln furniture light weight. Consequently, the firing had improved with tangible results.

We also switched to NATURAL GAS from liquid fuel as main source of energy for the kilns.

Presently, we are producing every month about 750 MT of ceramic sanitary wares and our monthly fuel consumption is about 63000 Cubic Meters.

We are keen to further enhance our capabilities through participation in similar programmes under the aegis of UNIDO.

With regards

Yours truly,

ARISTON CERAMIC

PARTNER

Annexure 13

List of participants: UNIDO training programme on energy efficiency

UNIDO Workshop on Fuel Efficiency Measures
25th-27th, Aug 2008 at CGCRI, Khurja

S. No.	Name of Industry	Participants Name	Sign
1.	M/s Anupam Pottery	Mr. Mukesh Sharma	
2.	M/s Naresh Potteries	Mr. Ravi Kumar	
3.	M/s Silico & Chemico Porcelain Works	Mr. Dilip Prajapati	
4.	M/s Silico & Chemico Porcelain Works	Mr. Akhilesh	
5.	M/s Chhabra Industries	Mr. Razi Ahmad	
6.	M/s Daya Potteries	Mr. Navin Sachdeva	
7.	M/s Shiv Potteries	Mr. S. P. Sharma	
8.	M/s Pratap Ceramics	Mr. Narendra Yavad	
9.	M/s Gulathi Ceramics	Mr. Karan Gulathi	
10.	M/s Gulathi Ceramics	Mr. Ashok	
11.	M/s Gulathi Ceramics	Mr. Somdutta	
12.	M/s Vineet Decorators	Mr. Sanjay Bansal	
13.	M/s Vineet Decorators	Mr. Sheel Kumar	
14.	M/s A. K. Ceramic Kiln Contractor	Mr. Imran	
15.	M/s Anas Engineering Works	Mr. Sharafat Ali	
16.	M/s Hi-tech Engineering Works	Mr. Riyasat	
17.	M/s Shawa Pottery	Mr. Nadeem	
18.	M/s Dadoo Pottery	Mr. Hari Dadoo	
19.	M/s New Adarsh Pottery works	Mr. Sanjay Gupta	
20.	M/s Nawal Ceramics Pvt. Ltd. C-7 Ind. Area, Khurja	Mr. Saurabh Aggarwal	
21.	M/s Ramanuj Electro-Ceramics	Mr. Tanmay	
22.	M/s C.G.C.R.I., Khurja	Mr. Rajat Kaushik	
23.	M/s C.G.C.R.I., Khurja	Mr. Amit Rajendra Maliya	

TRAINING PROGRAMME SCHEDULE - KHURJA

Day	10.00 to 11.15	11.30 to 13.00	14.00 to 15.15	15.30 to 17.00
25.8.08	Demonstration of use of instruments, measuring the readings and adjustment of different controls to have desired readingsin Shuttle kilns and tunnel kilns **IVRK / Venu Kumar**			
26.8.08	Areas of Energy Management in Kilns (Practical Aspects) **VPR**	Energy Audits. Monitoring and targeting **IVRK**	Practical by the trainees in different kilns	
27.8.08	Kiln firing systems, burners, blowers and efficient operation of kilns. **VPR**	Heat Loss, combustion (basics), electrical and instrumentation **IVRK**	Practical by the trainees in different kilns	

IVRK: IVR Kumar		**VPR: V P Rastogi**

UNIDO TRAINING PROGRAMME ON ENERGY EFFICIENCY

LIST OF PARTIPANTS - THANGADH.

DATE 23RD JULY TO 26TH JULY 2008

SL.NO.	NAME	DESIGNATION	COMPANY	SIGNATURE
1	Ashokbhai Vaghela	Owner	Sunny Ceramics	[illegible]
2	Jay Jadwani	"	Jay Ceramics	[illegible]
3	Mayurbhai Gotka	"	Max Ceramics	[illegible]
4	Nimishbhai	"	Newlight Cer.	[illegible]
5	R. L. Devasani	Kiln consult.	Raj Ceramics	[illegible]
6	Pushpak Patel	Owner	Himalay Cer.	Pushpak
7	Sandip Makhasana	"	Royal Cer.	Sandeep J. Prajapati
8	B. J. Parmar	Kiln consult.	Mark Cer.	B. J. Parmar
9	C. K. Pandya	Kiln op.	Sunrize potts.	[illegible]
10	Hemantbhai Mehta	Owner	Litco potty	[illegible]
11	Radheram	Kiln operator	Laxmi Cer.	[illegible]
12	S. C. Bhoomia	Owner	Meibah Cer.	[illegible]
13	Subhash Prajapati	"	Prem Refra.	[illegible]
14	Maganbhai	Kiln operator	Ashok Cer.	[illegible]
15	Prajapati Mankar	Kiln operator	Prajapati Ref	[illegible]
16	Milan M. Dubal	Owner	Uday Ceramics	[illegible]
17	Ashokbhai	Owner	Ollwayum	
18	Rathurambhai	Operator	Akshar sants	P. D. Rao
19	Sureshbhai	Owner	"	[illegible]
20	Shankarbhai Prajapati	Owner	Sarvoday Ceramics	[illegible]
21	Pravin T. Mulji	Owner	Ashok Cer.	[illegible]
22	Bharat Badrakia	operator	Prajapati Ref	Bhadesh
23	Ramesh P. Mabua	operator	Arati Cer. Ind.	[illegible]
24	Gagubhai	operator	Paradise pot	[illegible]
25	B. B. Rana	Kiln cum consult.	Pankaj Cer.	[illegible]
26	Girish Parmar	Kiln operator	Pankaj Cer.	[illegible]

UNIDO TRAINING PROGRAMME ON ENERGY EFFICIENCY

LIST OF PARTIPANTS - THANGADH.

DATE 23RD JULY TO 26TH JULY 2008

SL.NO.	NAME	DESIGNATION	COMPANY	SIGNATURE
	Ashokbhai Vora	Owners	Sagar bottling	Ashok
	Dhirenbhai Moradiya	"	Oshiya Industries	[illegible]

TRAINING PROGRAMME SCHEDULE- Thangadh

Day	10:00 to 11:15	11:30 to 13:00v	14:00 to 15:15	15:30 to 17:00
24 July 08	Demonstration of use of instruments, measuring the readings and adjustment of different controls to have desired readings Tunnel Kiln)		Demonstration of use of instruments, measuring the readings and adjustment of different controls to have desired readings (Tunnel Kiln)	
25 July 08	Areas of Energy Management in Kilns(practical aspects)AKG	**Energy Audit, Monitoring and Targeting** IVRK	Practical by the trainees in different kilns IVRK/AKG	
26 July 08	Kiln firing systems, burners, kiln furniture and Energy Efficient operation of Ceramic Kilns AKG	Heat losses in Ceramic kilns, Basics of Combustion Electrical and Instrumentation IVRK	Practical by the trainees in different kilns IVRK/AKG	

AKG: Mr.A K Gupta
IVRK: I V R Kumar

UNIDO TRAINING PROGRAMME ON ENERGY EFFICIENCY
LIST OF PARTIPANTS- Morbi

Date: 21st July to 23rd July 2008

Sl.No	Name	Designation	Company	Signature
1	Jitu bhai Maksan Ceramic	Kiln Operator	Maksan Ceramic	
2	Harsad bhai	"	Opson Ceramic	H.K. Lakhad
3	Rajesh bhai	"	Birmani Ceramic	
4	Bipin Bhai	"	Super tiles Ind.	
5	Bhanji Bhai	KILN INCHARGE	Simpolo Ceramic	
6	Moazam Parmar	KILN SUP.	"	M. A. Parmar
7	Chanjan Bhai	"	Vardan Ceramic	
8	Paresh Patel	"	"	
9	Uttam Patel	"	"	
10	Thusar Joshi	"	Weldecor Ceramic	
11	Mansuk bhai	"	Opal Ceramic	
12	Vinod bhai	"	Oson Ceramic	Vinod Singh
13.	Vidja Ashvin.	plant incharge	Soriso Ceramic	
14.	Dineshbhai Patel	Kilin incharge.	Soriso Ceramic	

UNIDO TRAINING PROGRAMME ON ENERGY EFFICIENCY
LIST OF PARTIPANTS- Morbi

Date: 21st July to 23rd July 2008

Sl.No	Name	Designation	Company	Signature
15.	Dipakbhai Patel	plant incharge	soriso ceramic	
16	Anand Patel	Director	Landmark Tiles	
17	Arvind Ramji.	--	Landmark tiles	
18	Kishor Patel	Director	Soma ceramic	
19	Bhanjibhai Dadh	Plant incharge	Soma Field Ceram	
20	Dinesh Bhai.	Operator	NEW Royal Ceram	
21	Rajesh/Kaush Tiwari		M/s Royal Ceram	
22	Vipul P. Patel	Patel	Salon Ceramic	
23	[illegible]	[illegible]	[illegible]	
24	[illegible]	[illegible]	[illegible]	
25	J. Kumaravel	Kiln Incharge	Soriso Ceramic	
26	Pravinbhai	Incharge	Gokul	
27	Gautambhai	Incharge	Radiant	
28	R.G. Singh	Operator	Gangotri	

UNIDO TRAINING PROGRAMME ON ENERGY EFFICIENCY
LIST OF PARTIPANTS- Morbi

Date: 21st July to 23rd July 2008

Sl.No	Name	Designation	Company	Signature
29	Ashwinbhai	Operator	Vrindavan	
30	Rajubhai	"	Somex	
31	Lalitbhai	Incharge	Nobel	
32	Jayeshbhai	"	Sungold	
33	Arvindbhai	"	Angel	
34	Premchand bhai	Operator	"	
35	Mansukhbhai	Incharge	Somex	
36	Meghajibhai	"	Sanyo	
37	Alpesh bhai	"	Suzuki Ceramic	
38	Gautam bal	"	"	
39	Mukesh bhai	"	Accord Ceramic	
40	Bhavin bhai	"	Homedecor Sanitary	
41	Danish bhai	"	Sunsilk Ceramic	

TRAINING PROGRAMME SCHEDULE- Morbi

Day	10:00 to 11:15	11:30 to 13:00v	14:00 to 15:15	15:30 to 17:00
21 July 08	Demonstration of use of instruments, measuring the readings and adjustment of different controls to have desired readings (Roller Kiln)		Demonstration of use of instruments, measuring the readings and adjustment of different controls to have desired readings (Tunnel Kiln)	
22 July 08	Areas of Energy Management in Kilns(practical aspects)AKG	**Energy Audit, Monitoring and Targeting** IVRK	Practical by the trainees in different kilns IVRK/AKG	
23 July 08	Kiln firing systems, burners, kiln furniture and Energy Efficient operation of Ceramic Kilns AKG	Heat losses in Ceramic kilns, Basics of Combustion Electrical and Instrumentation IVRK	Practical by the trainees in different kilns IVRK/AKG	

AKG: Mr.A K Gupta
IVRK: I V R Kumar

Annexure 14

Replication of EE measures and technologies in Khurja and Morbi

Khurja

Some of the units which have adopted EE measures and best practices and some concepts of lean manufacturing:

1. M/s Chhatwal Ceramic
2. M/s Chhabra Ceramic
3. M/s New Adarsh Pottery
4. M/s Shawa Pottery
5. M/s Bathla Ceramic
6. M/s Krishana Ceramic
7. M/s Bright Ceramic
8. M/s Tomar Industries

Morbi

I. Shift from Tunnel to Roller Kilns: 90% tile manufacturing units
II. Change in Kiln Furniture (to light weight furniture) in Tunnel Kilns: 80% units