DFID Project R7413:
Mechanisms to Improve Energy Efficiency in Small Industries

Part Two: Pottery in India and Khurja

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PART 2: POTTERY IN INDIA AND KHURJA

PREFACE

The main objectives of the DFID Project R7413 are to promote mechanisms to increase the adoption of energy efficient technologies and practices in the case of one small scale industry sector in India and Ghana. The sector chosen in India is the ceramic sector. The focus of the work has been in one large cluster of ceramic firms in Khurja, India. The process followed in the project has been to:

- map the operational practices in a sample of units and develop working relationships with relevant stakeholders;
- examine existing practices to determine possible improved practices that could be adopted including new technologies in the main energy using parts of the operations, and,
- analyse the extent to which energy efficiency gains can be achieved in a manner that is also financially attractive to the firms.

Finally, the intention of the project is to examine the barriers to the adoption of improved technologies and to suggest specific interventions to reduce the barriers. This is provided that the suggested improvements are found to have a sufficiently high rate of financial return, making them potentially sustainable without subsidies.

This section first examines the pottery industry in India. This is followed by a more detailed examination of Khurja and its pottery industry. This includes an account of the history of the pottery industry in Khurja. The current status of the pottery sector is examined in detail, including current production levels and markets, employment levels and the environmental impacts of the industry. At the conclusion of the section, attention is given to the pattern of energy use in the pottery industry, with particular reference to kilns.

The work done in India is detailed in the following sections:

Part One	*Poverty and Energy Efficiency in Small Industries – A Review of the Issues*
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POTTERY IN INDIA

An initial survey (IDS) found information on 100 pottery manufacturing clusters in India. Many of these are small clusters and the data available on them was not very detailed. More detailed information was available on 24 clusters from fourteen different states and this is provided in see Annex 1.

The Indian ceramic industry can be broadly divided into two major groups, whiteware pottery and red clay pottery (including terracotta), which are both produced in India. The products of each of these groups are listed below.

Red Clay

1. Building Bricks
2. Roofing tiles
3. Utility articles such as kulhar, saucers, surahi, matka sets

Whitewares

1. Cups, saucers, mugs, tea-sets
2. Stoneware kundis, jars
3. Pressed porcelain insulators and other LT and HT insulators
4. Chemical porcelain items
5. Decorative pottery items such as flower vases, toys, ash-trays
6. Fire bricks, saggars and other heat resisting items.

The 24 clusters identified in the survey, including the cluster in Khurja, produce predominantly whiteware, although also some small amounts of terracotta are also produced. Terracotta tiles are popular in Southern India, while utility items made from red clay are ubiquitous in the country and tend to be made by the smallest and also more rural units. There is a new demand for high fired terracotta ware in the export markets which is being met by some larger units in Khurja. This is actually a non-traditional product in the sense the clay composition is different and the ware is fired at a much higher temperature. There by this product has a higher lustre and lower porosity.

Beyond the 100 clusters identified and the 24 clusters for which data is available, there are thousands of pottery units scattered across India which have not been cited nor surveyed as part of this project. Many villages and towns have small traditional pottery units making low fired utility items. None of these have been studied here.

In the 24 clusters for which more information was available, the data shows that there were 2,191 individual pottery units with estimated sales per month of 445 million Rupees

or annual sales of almost 6000 million Rupees (US$150 million using an exchange rate of US$1 = 40 Rupees). The smallest cluster identified, Chinat in Uttar Pradesh, had only 6 units and estimated per monthly sales of 1.6 million Rupees. The largest cluster identified was Khurja (in Uttar Pradesh) with 491 units and annual sales of almost 2500 million Rupees. Clearly Khurja is the single most important pottery cluster in India composed of small scale units. Of the sample of 24 clusters, it is estimated that the Khurja cluster alone accounts for 25% of the manufacturing units and over 40% of the production.

The industry is labour intensive. Almost 95,000 people are estimated to be employed by the 24 clusters surveyed (this is likely to be an under estimate for reasons discussed later). The above data suggests that the output to labour ratio is 60,000 Rupees (US$1,500) in the 24 clusters.

The industry is also energy intensive. The firing of the clay in kilns and dryers account for most of the energy consumption. Fuel used to power the kilns includes gas, electricity, diesel oil, kerosene, coal, wood and cow dung. Of these wood and cow dung are used in smaller and rural kilns, while coal is probably the most common fuel used by the largest number of units. Electricity is rarely used because of high costs and erratic supplies due to shortages in the country. The fuel of choice is diesel oil or kerosene in the newer oil fired kilns. Gas is not common again due to supply constraints in India. But it is very likely that the availability of gas and its use will increase slowly as more natural gas pipelines are being built.

Environmental problems arising from the ceramics industry in India include air pollution from combustion, coal ash disposal, effluents from the clays and possible impact on deforestation where wood is predominant.

Ceramic ware is produced both for the domestic market and for export. But over all export markets are unlikely to be more than 10-15% of total production. There is increased imports of ceramics in the higher price range and the smaller units face competition from large scale manufacturers also.

Table 2.1

Ceramics	**India - SME**	**Khurja**	**India*[1] Large Scale**	**UK*[2]**
Value of production	$150 million	$62 million	$230million	$3,000 million
Employment	95,000	25,000	27,000	62,000
Output/Labour	$1,500	$2,500	$8,500	$48,000

* Source [1]–CMIE publication on Annual Survey of Industries, 1995-1996;
[2] -www.energy_efficiency.gov.uk/eebpp/eebpp-template.cfm

POTTERY IN KHURJA

Khurja

Khurja town had a population of 107,600 as at the last general census in 1991 and is currently the sixth largest town of the National Capital Region. Its present population may be estimated at around 150,000, while awaiting the results of the 2001 census. It is located in the state of Uttar Pradesh (UP) and is part of the Bulandshahr district. Khurja is around 100km from Delhi, mostly east and a little south, on the Grand Trunk Road which continues on to Kanpur, and beyond to Calcutta. It takes about 2 to 2.5 hours by road from New Delhi to Khurja. Khurja is also an important railway junction by virtue of linking Kanpur-Varanasi and Calcutta on one side, and Delhi on the other. The total area of Khurja is 549,186 hectares. Its climate is hot and dry with a maximum temperature of 48 ^{o} C and a minimum temperature of 3^{o} C; it has an average yearly rainfall of 580 to 690 mm.

Khurja is a prominent industrial and commercial town in Bulundshahr district. The two main employment and livelihood sources in Khurja are pottery and agriculture, at roughly 50% each. The pottery industry directly employs about 25,000 workers with a further 5000-7000 employed in various support services and allied activities. Other sources of employment in Khurja include trade and commerce and a very small amount of other manufacturing.

Infrastructure

Khurja is well located and overall has reasonably good infrastructure. It is accessible by road and railway, is connected to the State Electricity Grid, has sufficient water supply, a nationally and internationally connected telephone exchange, good educational facilities and 9 branches of national banks. Like many parts of India, while these connections exist, in many ways the quality of the infrastructure remains poor. It suffers from poor road condition, lack of regular power due to overall supply shortages and inadequate healthcare facilities. There are some problems with waste water drainage and considerable room for improvement in solid waste disposal. A short description of Khurja's infrastructure is provided below.

Transport

The major transportation route to Khurja is the main Grand Trunk Road. Other entry points to the town of Khurja include Delhi-Bulundshahr, Aligarh, Shikarpur, Pahasu and Jewar. There is a perception that access roads to Khurja and roads within the town need to be upgraded. Khurja railway station is an important railway junction and lies on the main Delhi-Kolkata Grand Trunk Road. The pottery units primarily use road to transport their products as the railway services are reported to be inadequate.

Power Supply

Khurja receives its power through the State Electricity Grid. The town itself has 4 electric sub-stations with a total capacity of 28 MVA; however each of the substations are overloaded by at least 25 per cent. Most of the electricity network is currently in need of repair or replacement. Due to these problems the town, including all pottery units, generally experience a shortage of power and frequent power outages. As a result numerous people, in particular commercial and industrial enterprises, resort to the use of standby diesel generators.

Water Supply & Sanitation

The water supply in Khurja is sufficient, meeting both domestic and industrial purposes. Approximately 2,880 kilo litres of water is supplied to Khurja on a daily basis. There is however an acute waste water drainage problem. The consequent water logging has lead to various water pollution problems.

Solid Waste Management

Khurja's solid waste is collected manually by hand carts and cattle drawn vehicles. Although the collected waste is disposed of in designated disposal areas, it does not undergo segregation or any other waste disposal techniques.

Telecom Services

Khurja town has a telephone exchange and is connected nationally and internationally. Internet service has recently been started in the town by a national service provider, Videsh Sanchar Nigam Ltd. (VSNL).

Educational Facilities

Educational facilities in Khurja are fairly good as can be seen below.

Table 2.2

Education Facility	**Number**
Technical Institute	1
Degree Colleges	2
Intermediate Colleges	4
High Schools	1
Junior High School	12

The technical institute provides the trained/skilled manpower to the pottery cluster.

Healthcare Facilities

Khurja town has two government hospitals with a total capacity of about 80 beds. In addition there are a few private nursing homes, one family and child welfare center and also private doctors. The existing health care facilities are grossly inadequate. For instance, less than 4% of the workers are covered under the employee health insurance scheme.

Banking

Khurja's banking needs are in principle well met by the presence of nine public sector banks in the town, two of which have more than one branch.

Table 2.3

Name of Bank	***Branches***
Allahabad Bank	1
Central Bank	1
Oriental Bank of Commerce	3
Punjab National Bank	2
Punjab & Sind Bank	1
State Bank of India	1
State Bank of Patiala	1
Syndicate Bank	1
Union Bank	1
Total	***12***

The firms raised a number of issues related to their lack of access to bank finances. Some of the generic difficulties are connected to the bureaucratic rigidities of the banking and financial systems, and, the others are caused by the low transparency provided by SME owners with regards to their operations. Small scale units in general face difficulties in securing bank finance due to various formal procedural requirements – such as proper accounts, production statistics and other documentation – which they are often unable to fulfil. But many of these processes are necessary for any banking system and banks will always be unable to deal with borrowers who cannot provide a full and clear account.

Industrial Estates

Among the support provided to promote an efficient pottery cluster in Khurja have been the development of two industrial estates. The first is in an area of 17 acres on the Grand Trunk Road which has been developed with 18 industrial sheds and two plots. It is entirely devoted to pottery and all units are fully operational here. The second is on

Junction Road and has been developed by UP Small Industry Corporation and is a little larger at 30 acres. At present 25 pottery units are operating on this site.

The History of Pottery In Khurja

Origins

There are at least two conflicting versions of the origins of the pottery-manufacturing sector in Khurja. In one version there was a historical cluster of traditional potters, who had established them selves in Khurja, several hundred years ago. In this version potters from Egypt and Syria accompanied the Afghan King Taimur Lung when he passed by Khurja on an easterly campaign 500 years ago. In another, the origins of the tradition go back to people with knowledge of pottery who had moved there during the Mughal empire. In another opposing version, there is supposedly no long historical tradition of pottery in Khurja, but the second is highly unlikely, though the extent of production was probably low.

Nevertheless, in both versions of the history, the more modern phase of pottery manufacture began in the 1940s, with the establishment of a pottery factory by the UP Government in 1942. This unit was set up to meet the demand for sanitary ware, as imported supplies were disrupted by the war. A decade earlier, in the 1930s, the UP Government had appointed a Professor H N Roy – who had just returned from England with training in ceramics – to conduct trials on whiteware pottery in Khurja. He was to generate interest amongst the traditional potters in making whiteware from conventional raw materials. This first effort at providing technical support and to promote innovations among the local potters proved to be unsuccessful.

The UP Government factory, set up in 1942, produced pottery for the defence department. After the war, the items under production changed. Their product quality however was so poor that demand was virtually absent and the factory was closed in 1946-47. To avert complete financial loss on the part of the government, the factory was then transformed into a Pottery Development Centre (PDC) in 1952 with a promotional role. The potters who had earlier worked in the government factory, were allowed to draw their requirements of processed raw materials from the centre and were also provided with the facility of firing their wares on payment of nominal rent in the government kilns. In the year 1946 the UP Government established the Pottery Development Office (PDO) to promote the pottery industry in Khurja and provide training to entrepreneurs and workers. The number of potters in Khurja started to increase, but slowly during the 1940s.

1950s and 1960s

The Khurja pottery cluster experienced a stronger growth in the late 1950s and 1960s. The industry remained essentially cottage until the end of the 1950s, with there being only 3 units independent of the Pottery Development Centre (that is besides dependent potters, whose numbers are unknown, who used the common facilities provided by the PDC).

The 1950s and 1960s were characterised by a number of interventions and support measures for the industry. In the early 1950s the UP Government sent its ceramics expert, Dr T N Sharma, to Japan to obtain advanced training in porcelain manufacture. and the second, was to ask the Government of India to take up collective marketing for the Khurja pottery cluster. Dr Sharma returned to Khurja in 1955 and he reported that fine porcelain could be produced in Khurja using raw materials available in India if the required equipment could be made available and the Japanese techniques for making fine porcelain were adopted. He also promoted an improved type of profile for jiggers, expanded use of setters and improved saggar designs (Sharma 1976).

The request of the UP Government to the Government of India for marketing assistance resulted in the establishment of a Marketing Depot by the National Small Industries Corporation (NSIC) in late 1956 for marketing and promotional activities. The depot was able to make some contribution to increased sales, improved sale prices and it reduced internal competition amongst the pottery units which had earlier caused prices to fall rapidly (Sharma 1976).

In the late 1950s and early 1960s a number of additional initiatives were also undertaken to support the pottery industry in Khurja.

- In 1959-60 a design extension centre was set up as a branch of the Central Design Centre in Calcutta (the result of this initiative is unknown);

- In 1961 the All India Handicrafts Board invited a German pottery expert, Mr William Mosech, to train people in the making of glazed red clay pottery and artistic pottery using common clay. Although he was reported to produce “exquisite” pottery, “no concerted efforts were made to produce red clay pottery after he left the country”[1] or this effort did not get taken up by the industry;

- In 1962 a High Tension Laboratory for the Testing of Insulators was established to support the industry in getting their electrical insulators tested and certified locally. The Laboratory activities were integrated with the role of the PDO. Two experts visited the laboratory under the UN Technical Assistance Scheme and assisted in developing testing protocol and the production of insulators.

[1] Sharma “Let Us Also Turn Our Common Clay Into Gold”

By 1965-66 there was a total of 160 pottery units operating in Khurja. Of these 88 were independent units with their own firing facilities, and the other 72 units relied on the common facilities of the PDC. During this period and continuing on to the late 1980s all coal supply was controlled by the government. So all units were dependant on quotas for coal and these and the supplies were arranged by the PDO.

1970s – 1980s

During the 1970s, after the nationalisation of banks in the country, government policy mandated the liberalisation of industrial loans to smaller enterprises in India. With this opening of access to larger financial resources, a large number of entrepreneurs with no previous background in the ceramics industry began entering the industry. They set up larger units (though still in the small scale sector, but larger than had been common earlier) between 1973-75 and again in 1979-82. In this period the growth of units was predominantly in the form of independent units and their number rose to 271. Besides these there was some growth of the units depending on the PDC's facilities and these rose to only 126 units.

It is reported that the PDC was increasingly inefficient and was slowly loosing the support of the pottery units. The figures above suggest that those who could afford to invest the higher amounts of capital increasingly decided to avoid the PDC. With increasing losses, in 1982, the UP government transferred the common facilities it had provided to dependent potters to manufacture their goods, to the UP Small Industrial Corporation (UPSIC). The UPSIC attempted to run the facilities on a more commercially sound basis and made various new investments in equipment. But it was soon running into a competitive relationship with the private units and was unable to either provide support or competition. The losses quickly mounted and the facilities were completely closed down within a few years, by the mid-1980s. Since that time they remain closed and standing idle, a monument to industrial archaeology. Many commissions have been appointed subsequently but no resolution of the issues have taken place in over 15 years.

1980s-present

From the mid-1980s the Khurja pottery cluster started to witness higher growth rates. Production has increased rapidly in the past 15 years from 63.3 million Rupees in 1986-87 to between 1600-2500 million Rupees in 1999-2000. Since 1995 there has been a steady growth in the installation of oil fired shuttle and tunnel kilns. Prior to this only coal-based downdraft kilns had been used for firing wares in Khurja. This development will be discussed in more detail in the energy consumption section below.

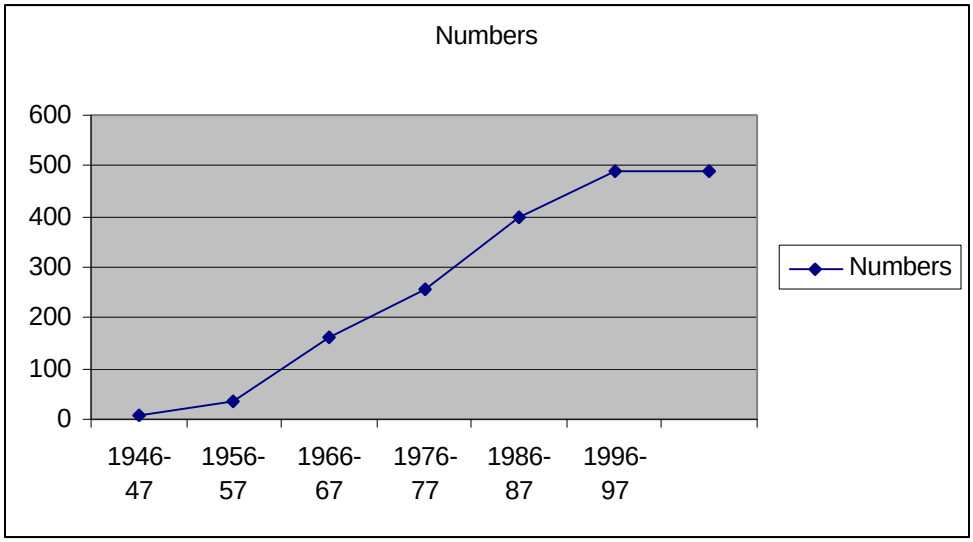
Table 2.4 Growth of Pottery in Khurja

Year	No. of Units	Production (Rs Mn)
1946-47	8	0.03
1956-57	37	0.2
1966-67	162	1.7
1976-77	255	9.4
1986-87	397	63
1996-97	491	840
1999-2000	491	1600-2500

Source: RITES 1992 and PDC

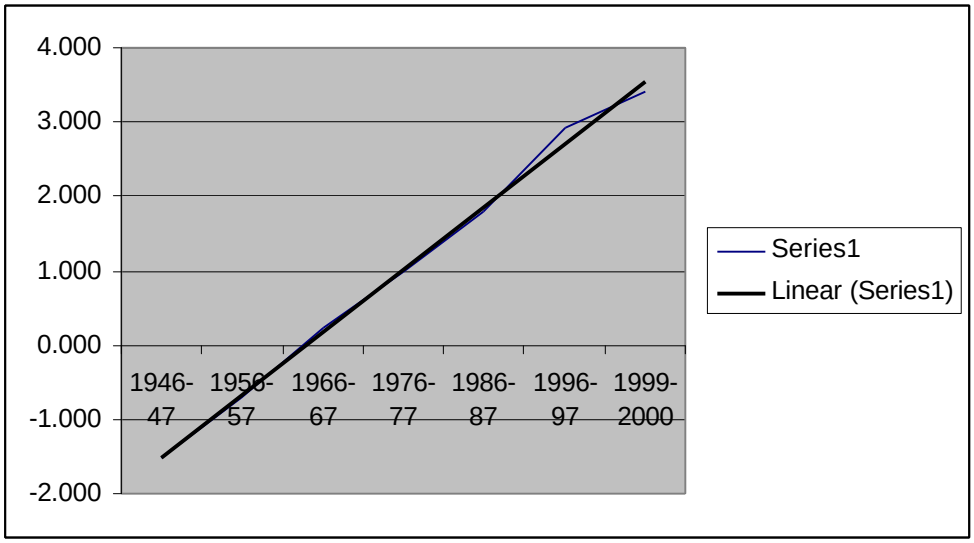
Note: The numbers that are quoted in the official figures of firms and narratives of the industry often diverge by 10-20%. The production figures are likely to have higher margins of error. But we believe they represent the overall picture.

Number of Units over Time



The growth of the number of operating units in Khurja is shown above. The graph suggests that there was a period of relatively slow growth in the number of units in the first decade. The next four decades saw almost an uniform rate of growth of around 12-14 new units per year until the early 1990s. since then the number of units has remained stagnant.

The graph below shows that the total value of production was on the other hand growing at exponential rates. It can be presumed that over time each unit continued to expand its output. It should be noted that the above numbers in Rupees are not deflated for inflation which has averaged at around 10% per year and to that extent provide an inflated picture of the true growth rate in Khurja.



Log of Output in Rupees against Year

CURRENT STATUS OF THE POTTERY SECTOR IN KHURJA

Products

The main items produced by independent pottery units in Khurja are listed in the table below, in conjunction with the number of units manufacturing each type of product and the respective production value. Chiefly whiteware is produced in Khurja, however there is also a small amount of high fired terracotta being produced for export markets. Most pottery units in Khurja manufacture crockery (stoneware), HT/LT insulators and decorative wares (stoneware). There are only a few specialized units that manufacture sanitary wares, bone china and chemical porcelain.

Table 2.5: Number of Units (Independent) According to Type of Products Manufactured and their Production in 1996-97

Name of Product	Number of Units	Production (Mn Rs)
Crockery wares	273	437
Art Wares	65	92
Electrical Goods	103	227
Scientific Goods	6	17
Sanitary Wares	2	8
Bone China Crockery	8	25
Electronics	4	5
Ceramic Jars	3	5
Refractories	3	3
Grinding Valves	2	2
Ceramic Tiles	2	2
Others (grinding, decoration)	20	17
Total	*491*	*840*

Source: PDC

Number of Operating Units

The latest information available from the PDO, KPMA and CGRI, indicates that there are 491 (independent) pottery units registered with the PDO. While not all of them are operating the number of operating units is not known exactly. In addition to the 491 independent units, there are around 150 dependent units of which, only around 60 units are currently operational. Again while the details on these are not available, the responses during interviews suggested that most of these are not doing too well as they do not have any captive raw material processing or firing facilities and were earlier

relying on the PDC. They procure body and glaze in readymade form and make greenware in their units; they rent kiln space from other units.

It is estimated that all units in Khurja produced around 2500 million Rupees worth of ceramics in 1999-2000 (PDO). The majority of the 491 units are traditional units. Almost all are at least ten years or older. They always started with low capital investments and use basic and old technologies. There are now about 130 modern units that have invested in shuttle and tunnel kilns moving away from the older coal fired down draft kilns.

Market

Khurja's pottery products are sold all over India and also exported. Within India products are sold directly and also indirectly through middlemen, shopkeepers and large godown owners. In our survey units ranged from those with 100% direct sales to the market to others who sold everything through traders.

There are about 23 export oriented pottery units in Khurja. Export clients include countries such as the United Kingdom, USA, Australia, New Zealand, United Arab Emirates etc. The major export items are ceramic artware, insulators and scientific porcelain. Historically Khurja's export levels have been low due to the cluster's inability to meet the stringent quality requirements of export clients. In 1999-2000, exports were valued at 148.2 million Rupees, representing between 6-10% of aggregate production. This proportion is reasonably typical, although exports have on occasion represented up to 15 per cent of Khurja's aggregate ceramics production.

Approximately one-third of exports are sold directly by manufacturing units located in the cluster and two thirds are through intermediary market agents (see Table 2.2). Major direct exporters include Dadoo Industries, SR Potteries, Darshan Ceramics and Silico Chemico.

Table 2.6

Year	Direct Exports (Rs Mns)	Indirect Exports (Rs Mns)	Total Exports (Rs Mns)
1997-98	30	60	90
1998-99	37.5	82.5	120
1999-2000	48	100.2	148.2

Source: TERI 2001

Production Process

There are three broad steps in manufacturing ceramics: preparation of the raw materials, preparation of the greenware and firing.

1. Clay is ground and mixed in a mixer. The clay is then mixed with water and made workable.
2. Clay is poured into moulds, extra material is cleaned or trimmed. Additional parts such as handles added if required. Additional forming processes such as turning and throwing are listed in the table below.

Table 2.7: Forming Processes

Inputs	**Process & Description**	**Outputs**
Casting slip moulds	*Casting* – pouring of slips into moulds	Final shaped greenware (unfired)
Plastic clay	*Jiggering* – forming of flatware using rotating wheel and formers *Jolleying* – as above but to make hollow ware (bowls, jugs, planters etc)	Final shaped greenware (unfired)
Leatherhard clay	*Turning* – similar process to a lathe for forming cylinder profiles	Final shaped greenware (unfired)
Plastic clay	*Throwing* – hand forming using potter's wheel	Final shaped greenware (unfired)
Plastic clay moulds	*Pressing* – forming of shapes using moulds and hydraulic press	Final shaped greenware (unfired)

3. The greenware is loaded onto trays and then placed in kilns. Terracotta and earthenware is fired immediately whilst porcelain and some other products are first glazed and then fired.

Sourcing Raw Materials

Surprisingly, given the amount of raw materials required, none of the raw materials required for making pottery are available locally in Khurja. So why Khurja became a home for the largest pottery cluster is a little bit of mystery but it suggests that the earlier historical developments were more than sufficient to provide the necessary impetus to the growth of this cluster in Khurja. It is quite likely that with the growth of the industry after the initial government support, after a point in time, its size provided economies of

clusters which together with relatively close access to metropolitan markets, could over come the disadvantage of raw materials.

Raw materials are thus procured through local agents in Khurja, of which there are about 25. The sources of the various clay raw materials are shown in Table 2.6 below. In addition to these, there are other raw materials and also chemicals that are used in the glazes such as zinc oxide, zirconia, barium carbonate, chromium oxide and soda feldspar. A few pottery units are sufficiently large and financially strong, so as to procure the raw material directly from places like Rajasthan, Delhi, Ahmedabad, Bikaner, Bihar etc. and certain chemicals from Agra, and as such do not have to deal with intermediary traders.

Table 2.8

Raw Material	**Source**
China clay	Rajasthan, Gujarat, Bihar, Calcutta, Delhi
Plastic ball clay	Bikaner (Rajasthan), Chandia (Madhya Pradesh)
Quartz	Jaipur, Udaipur, Ajmer, Alwar
Potash feldspar	Jaipur, Udaipur, Ajmer, Rajasthan
Fire clays	Delhi
Bikaner clay	Ahmendabad
Kundan clay	Kerela

Source: RITES 1992

Employment

The ceramic industry is highly labour intensive, requiring both skilled, semi-skilled and unskilled labour at every stage of production. The minimum number of workers in a unit in Khurja ranges from about 7 to 10, and the maximum reported is around 30 to 40. An independent unit whose production is one ton per day, or 300MT per annum, will need about 40 to 50 workers. Many units are larger than the above and in fact require up to 300 workers. The firms have several incentives to report fewer workers than the actual numbers. As the numbers of workers go up the firms have to provide more benefits, compy with stricter labour laws and so on. The workers are further grouped into smaller numbers of “permanent” and larger numbers of “temporary or contract “ labour for legal reasons.

According to the statistical information available from the PDO, the current pottery manufacturing workforce at Khurja is around 15,000 (Table 2.7). This figure however is based on unit-wise information provided by the units themselves, and as a result has a major downward bias. A more realistic estimate of the current deployment of workforce

with pottery units at Khurja, based on a number of interviews, is placed at around 25,000. The breakdown of labour between skilled, semi-skilled and unskilled categories can be seen in the table below. About eighty per cent of these 25,000 workers are migrants from Bihar, West Bengal and Nepal.

The output to labour ratio in Khurja is around 100,000 Rupees (US$2,500). This is in comparison to the average output to labour ratio in the 24 clusters reported on earlier, where the ratio is much lower at 60,000 Rupees. This confirms the higher capital inputs used at Khurja compared to the average Indian small scale pottery manufacture.

Table 2.9

Category	Official Employment (Nos.)	Actual (est.) Employment (Nos.)
Skilled	8,000	10,000
Semi-skilled	5,000	5,000
Unskilled	2,000	10,000
Total	**15,000**	**25,000**

The estimates in the table above were prepared through informal discussions with a number of stakeholders in the industry in Khurja. There is a much larger discrepancy in the official numbers as compared to our estimated above for unskilled workers. We believe that this is because most of them are hired as “contract” labour and not as permanent employees. But many more of the skilled and semiskilled workers are required on a long term basis and are so categorised as employees.

In addition to direct employment of workforce by the pottery industry, a total of around 3,000 persons are engaged in various support services and allied activities; a broad-break up of these can be seen in the table below. Assuming a similar underestimation of the workforce in this category as per those in direct employment, we could easily estimate the actual number of people indirectly employed by the pottery industry to be between 5,000–7,000.

Table 2.10

Activity	*No. of Units / Establishments*	*Average Employment per Unit*	*Estimated Total Employment*
Body-mix making	15	20	300
Raw-material dealers	25	5	125
Transfer decoration units	30	20	600
Packaging material industry	4	80	320
Jute rope making units	3	10	30
Gunny bag making units	20	3	60
Pottery machinery manufacturers	10	8	80
Spares & tool dealers	15	3	45
Transporters	40	10	400
Transfer paper manufacturers	4	15	60
Khurja pottery wholesalers	100	5	500
Khurja pottery retailers	50	6	300
Labour for raw material handling / movement	25	6	150
Total			**2970**

Thus while we could collect the above figures, we believe that they suffer from some underestimation as well. Hence our estimate of total direct and indirect employment in Khurja is between 30,000 and 35,000.

Health Issues

With respect to health issues, only about 1000 workers or about 4 percent of Khurja pottery industry workforce are covered by Employees State Insurance Scheme (ESI). Under this scheme, they are entitled to free access to the medical facilities at the ESI Hospital.

No specific occupational diseases are associated with the Khurja pottery industry. An informal survey of private doctors found some suggestion of skin problems such as eczema amongst workers arising from the prolonged handling of clay and other materials such as glazes. Amongst the general Khurja population, the incidence of respiratory diseases such as asthma and bronchitis is somewhat higher than other populations. This is due to air pollution caused predominantly by the burning of coal (in downdraft kilns).

Pollution and Environmental Impacts

Policies and regulations regarding pollution in India are formulated by the Central Pollution Control Board (CPCB). Part of their duties include prescribing, at the national level, the Minimum Acceptable Standards (MINAS) regarding pollution for various industries, including ceramics. Each state then has a pollution control board, which is responsible for the enforcement of the CPCB's policies, regulations and standards. The state pollution control boards are allowed to specify higher standards than the MINAS for their particular state or special areas within the state but are not supposed to lower them.

In Uttar Pradesh, there are two zones which have special and stricter regulations – the Doon Valley (Dehradun) and Agra Trapezium. However, the Khurja pottery cluster does not fall within either of these two special zones and as a result is subject to the MINAS as developed by the CPCB for the ceramics industry. The regulations come under the Environment (Protection) Rules" of 1986. These MINAS are implemented by the Uttar Pradesh State Pollution Control Board (UP SPCB).

The major environmental problems arising from the pottery industry in Khurja are air pollution due to coal firing, the disposal of coal ash and effluent problems arising from the process of wet grinding. The UP SPCB has been aware of the significant, adverse environmental impacts generated by coal based down draft kilns for a number of years and has been asking the pottery units to take appropriate measures to rectify the problem. The main measure recommended is to build new and higher chimneys for coal fired kilns.

In meetings between the KPMA and the UP SPCB over the past few years the former has pleaded for leniency in the enforcement of MINAS. The KPMA have argued that the pollution control equipment required to meet MINAS were beyond the technical capability and financial means of the pottery units.

The UP SPCB has tended to be sympathetic towards the KPMA's requests, acknowledging the poor financial position of a number of the pottery units in Khurja. It has offered a "relief period" where it does not implement the MINAS to give units time to make modifications. Although in 1997 it did issue notifications to two units to cease their operations.

The UP SPCB is not pressing for compliance on the coal fired kilns as it believes that with the strong trend away from coal to diesel, the problems caused by coal firing will disappear. Hence remedial steps to improve the coal fired kilns, which are any way on their way out, would not be economically justified.

ENERGY USE IN POTTERY

In general the energy efficiency of many industrial operations in India are poor compared to world averages. The efficiency of SMEs is also generally expected to be lower than that of more sophisticated larger units with better equipment and management. According to a study by Dalal Consultants, the energy used in the small scale Indian glass industry average for pot furnace performance (MkJ/MT of glass draw) is more than 4 times higher than the national benchmark and more than 6 times higher than the international benchmark. Some units consume over 11 times more energy than the international benchmark. The highly energy intensive ceramics industry would be expected to follow a similar trend.

The major consumers of energy in the production process are kilns and dryers; together they usually constitute more than 70% of an entire pottery unit's energy consumption (see Table 2.9 below). In Khurja however, little use is made of dryers, which pushes the kiln's (or kilns') energy usage alone up to 80% of total energy usage.

Table 2.11: Energy Use in Pottery Units

	% consumption	
Stage of production	**With drying**	**Without drying process**
Processing of raw materials	5-6	20
Fabrication of pieces	8-10	
Drying processes	20-25	80
Firing operation	60-65	

Source: *Technology Evaluation In Ceramics Industry*

The remaining 20-30% of energy is accounted for by the processing of raw materials and the fabrication of greenware described in the earlier table and below.

Use of Electricity

Electricity is used in the Khurja pottery units in the following ways:

- pulverizers (ball mills, jaw crushers);
- slip preparation (blunders, fitler press, pug mill, agitators);
- pumps;
- motors;
- compressors;
- fans and blowers;
- electrical testing;
- blowers and fuel pumps on shuttle and tunnel kilns (electrically operated);

- lighting etc.

Whilst electricity does not represent a large proportion of a pottery unit's total energy use, it is still requisite in the production process. The various problems associated with electricity supply in Khurja mentioned earlier such as frequent outages and unannounced load shedding significantly disrupt production cycles. The extent of this varies considerably between units, with a few little affected. Except for those few, all other units use standby diesel generators to produce electricity when the supply from the grid is not available.

Energy Efficiency in the Use of Electricity

Energy efficiency in the use of electricity is not accorded a high priority by Khurja pottery units since it represents a relatively small proportion of total of energy consumption and due to more general time and resource constraints. Nevertheless considerable opportunities to improve the efficiency with which electricity is used exist. These are mainly through:

- power factor correction and load factor improvement;
- optimum loading of pulverisers (that is, jaw crushers and ball mills)
- replacement of v-belts with modern flat belts;
- energy efficient lighting such as replacing incandescent lamps with fluorescent tubes;
- conducting cleaning and spray glazing with compressors at reduced pressures.

Kilns

A number of different kilns exist for use in the pottery industry in India and they can be classified and/or examined in a number of different ways. For example, whether they are muffle, semi-muffle or direct fired kilns, based on the nature of contact between the flame and the ware. The kiln may operate on a batch or a continuous production cycle. The kiln may use different types of energy. In Khurja three types of kilns are used: down-draft kilns, shuttle kilns and tunnel kilns. Diesel-fueled shuttle and tunnel kilns were first introduced in the early 1990s. Despite being late entrants, they are increasingly popular due to various operational advantages (discussed further below) as Table 2.10 illustrates. There are currently between 100 to 130 diesel fired, tunnel or shuttle kilns with a number being added currently. The type of kilns being used by each of the firms surveyed is shown in the Table 2.11.

Table 2.12 Shuttle/Tunnel Diesel Kilns in Khurja

Year	Shuttle kilns	Tunnel kilns	Total
1995			5
1997			15
1999	30	20	50
2000	50	50	100
2001 (estimate)	70	60	130

All down-draft kilns in Khurja are coal fired (although in other parts of India smaller units often use wood and cow dung). The shuttle and tunnel kilns in Khurja presently run on diesel oil. There are a small number of electric kilns. However, they are not used due to the higher unit cost of electricity as compared to other fuels such as diesel, and the highly irregular supply.

Only one company has been experimenting with a tunnel kiln using LPG. Unfortunately for them the pressure of the LPG cylinders they use has been too low to achieve the high temperatures required. There is however a possibility that piped natural gas may become available in the near future or the next few years.

The energy efficiency of kilns is defined as the heat used or required to fire the ceramic product divided by the total heat supplied to the kiln. The energy cost of kilns typically ranges from a low of 22% to a high of 35% of the sales value of production.

Table 2.13

Firm No.	Coal Down Draft	Electrical	Shuttle (diesel)	Tunnel (diesel)	TOTAL IN USE
1	Not in use	3 (not in use)	3	3	6
2	-	-	1	-	1
3	1	-	-	-	1
4	3	-	-	-	3
5	-	-	1	1	2
6	1	-	-	-	1
7	-	-	1	-	1
8	-	-	1	1	2
9	2	-	-	-	2
10	1	-	-	1	2
11	1	-	-	-	1
12	-	-	2	-	2
13	-	-	-	2	2
14	2	-	-	-	2
15	No captive kiln capacity				
16	Not in use	-	1	1 being installed	1
17	No captive kiln capacity, rents facilities available at another unit.				
18	1	-	1	-	2
TOTAL IN USE	12	0	11	8	31

Coal

Coal is made available to the pottery units in Khurja through a system of coal quotas and supplied through various collieries. The UP State Government allocates a coal quota for each pottery unit on the basis of its installed production capacity, which is reviewed annually, and the PDO is responsible for its administration. Most units however do not receive the full amount of coal allocated to them under the quota and are thus forced to purchase additional coal from the open market, which tends to be of an inferior quality. Until recently there was a subsidy for coal which probably increased the disincentives to SMMEs to be efficient. Coal is discussed further in later sections.

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