Cluster Profile Report
Tirunelveli Lime Kiln Cluster

Prepared for:

Small Industries Development Bank of India (SIDBI)

819, 8th Floor, Antriksh Bhawan, 22 Kasturba Gandhi Marg, New Delhi-110001
Tel 91 11 4079 1100 Fax +91 11 4079 1101 Email: desl@dalkia.co.in

Oct-12

Disclaimer

This document is an output of an exercise undertaken by DESL through a project funded by the Small Industries Development Bank of India (SIDBI) for the benefit of MSME units. While every effort has been made to avoid any mistakes or omissions, SIDBI would not be in any way liable to any person by reason of any mistake/omission in the publication.

Suggested form of Citation

DESL-2012
Cluster Profile Report – Tirunelveli Lime Kiln Cluster

Published By

DESL
Development Environergy Services Ltd
Formerly, Dalkia Energy Services Ltd.

For More Information

DESL
819, Antriksh Bhavan
22 Kasturba Gandhi Marg
New Delhi 110 001, India
Tel. +91 11 4079 1100 Fax. +91 11 40791101 Email desl@deslenergy.com
www.deslenergy.com

Printed in India at New Delhi

Conservation Redefined

CONTENTS

ABBREVIATIONS

BEE	Bureau of Energy Efficiency
CBRI	Central Building Research Institute
CII	Confederation of Indian Industry
CO_2	Carbon-di-Oxide
DESL	Development Enviro Energy Services Ltd
DIC	District Industries Commission
EE	Energy Efficiency
GEF	Global Environment Facility
MSME	Micro Small and Medium Enterprises
NLMA	Tirunelveli (Nellai) Lime Manufacturers welfare Association
SIDBI	Small Industries Development Bank of India
SME	Small & Medium Enterprises
SSI	Small Scale Industry
TANGEDCO	Tamil Nadu Generation and Distribution Corporation Ltd
TNPCB	Tamil Nadu Pollution Control Board
TPD	Tons per day
VSK	Vertical Shaft Kiln
WB	World Bank
WTA	Walk Through Audit
ZESPL	Zenith Energy Services P Ltd.

LIST OF TABLES

LIST OF FIGURES

LIST OF ANNEXES

ACKNOWLEDGEMENTS

DESL places on record its sincere thanks to the World Bank for its role in guiding and steering this prestigious assignment for “providing project development support for enhancement of energy efficiency” at Tirunelveli lime kiln cluster.

DESL is grateful to the Small Industries Development Bank of India (SIDBI) for its progressive management and also for vesting its confidence in DESL to carry out this prominent assignment for the Tirunelveli lime kiln cluster and providing full fledged coordination and support throughout the study.

The DESL team is thankful to the office bearers of Tirunelveli District Lime Manufacturers Welfare Association for showing keen interest in the study and providing their whole hearted support and cooperation for the preparation of this cluster profile report. We would like to extend our special thanks to Mr N Mariappan, President.

DESL would also like to place on record the valuable inputs received through interactions and deliberations with the state government officials associated with this cluster. Interactions with cluster coordinating agencies, cluster coordination committee members, entrepreneurs, technology providers who were directly or indirectly involved throughout the study are also gratefully acknowledged.

DESL

CERTIFICATE OF ORIGINALITY

This is to certify that this report is the original work of DESL. The study was jointly carried out by DESL team in New Delhi and on the field at Tirunelveli. The teams held detailed discussions and collected data from several industry stakeholders which covered Micro Small, and Medium Enterprise (MSME) entrepreneurs, senior plant engineers, industry associations, key local bodies, local service providers, suppliers, fabricators, manufacturers, experts, testing labs, academic institutes, banks/FIs, and local energy distribution companies. In addition to this, the team reviewed secondary literature available on the cluster. The cluster profile is an end product of both first-hand interactions/data and secondary literature on the cluster. Appropriate references have been indicated in places where secondary sources of data and information have been utilized.

CLUSTER PROFILE REPORT – TIRUNELVELI LIME KILN CLUSTER

EXECUTIVE SUMMARY

Small Industries Development Bank of India (SIDBI) and Bureau of Energy Efficiency (BEE) are jointly implementing a Global Environment Facility (GEF)/World Bank funded project, which aims at promoting energy efficiency in Micro, Small and Medium Enterprises (MSMEs) in five clusters viz Ankleshwar Gujarat), Faridabad (Haryana), Kolhapur (Maharashtra), Pune (Maharashtra) and Tirunelveli (Tamil Nadu).

Development Environergy Services Limited (DESL, formerly Dalkia Energy Services Ltd.) has been assigned to provide project development support for two of the aforementioned clusters- Faridabad and Tirunelveli. The main objective of the project is to create demand for energy efficiency investments in the clusters. DESL's scope of work in the assignment includes cluster profiling, carrying out walk through assessments in at least 20 units, detailed energy audit and implementation support for energy cost reduction project implementation.

This report has been prepared based on literature review of past work carried out in the cluster and interaction with key stakeholders.

CLUSTER SCENARIO

Tirunelveli district located in Southern Tamil Nadu, is well endowed with mineral resources. According to state government estimates there are over 65 micro and SSI lime manufacturing industries in the cluster, generating revenue of Rs 9 Crore and providing employment to over 480 persons[2]. DESL has carried out a survey of 20 industries in the cluster, having total installed capacity of 494 TPD and operating at 249 TPD. The vintage of units surveyed by DESL range between 32 years and 2 months. As per interactions with the Tamil Nadu Pollution Control Board, it is understood that requests for "consent to establish', continue to be received. The location of cluster is strategic with access to several industries having demand for industrial grade lime. However due to process limitations of existing country kiln, they are unable to serve this market.

STAKEHOLDERS IN THE CLUSTER

The key stakeholders in the cluster include the following

- **Industry Association**: Nearly 42 units are members of the Tirunelveli Lime Manufacturers Welfare Association, the Apex Organization of this project.
- **Government Organizations**: The main government organizations with whom the lime industries engage include the District Industries Centre (for setting up industry, getting requisite clearances and hand holding to resolve issues); the Department of Mines (for raw material) and the Tamil Nadu Pollution Control Board (for pollution clearance.
- **Vendors**: Kilns are made locally by employing masons. Equipment such as blowers, pulverizers, crushers are mostly sourced from within Tamil Nadu.
- **Banks**: The lead banks in Tirunelveli are Indian Overseas Bank and Tamil Nadu Industrial Investment Corporation.

MANUFACTURING PROCESS

The technology deployed in the units is an improvised version of traditional country kilns. While most small scale lime kilns in the country have shifted to vertical shaft limekiln technology, this cluster has not migrated due to the different nature of limestone available. The type of stone available from local quarries (2 of them) include both calcite ($CaCO_3$ content > 85%) and dolomite ($CaCO_3$ content of 55-60%). The limestone is reported to have a crystalline structure, which is harder and therefore more energy intensive. 2 units have implemented technology upgrades in the last 5 years, which have failed and this has inhibited more units from venturing into technology migration. At least 6 units have come up in 2011 and 2012, with the traditional country kiln technology.

As a result of low-end technology used, the limekilns in the cluster are mostly using dolomite as raw material. The product is therefore of lower grade and more suitable for applications like whitewashing and water treatment. This has a seasonal demand and hence the units operate on an average 200-250 days a year.

The Association's immediate objective is therefore implementing a project with vertical shaft kiln technology with biomass gasifier which can be replicated across the industry. This can not only help improve product quality (and hence revenues), but also achieve reduced energy consumption.

ENERGY USAGE & CONSERVATION

The main sources of energy in the cluster are electricity (50-55 kWh per ton of lime) and wood based charcoal (180 kg per ton of lime). Energy cost as a percent of total manufacturing cost is about 67.5%.

In existing kilns, opportunities for conservation to reduce heat losses can also result in improved product quality. These opportunities are in recovering heat from exhaust, reduction in losses from kiln wall and top of the kiln through radiation, excess air control and improving air distribution for uniform calcination. While technology for such retrofits are well established in other industrial sectors, design of appropriate retrofit and demonstration is required for this cluster.

SWOT ANALYSIS

Table 1: SWOT ANALYSIS

Strengths	Weakness	Opportunities	Threats
• Experience in lime manufacturing - endurance and adaptability from this • Active role played by the association and at individual industry level to upgrade –e.g. finding alternate sources for high grade stone; research for potential industrial grade lime markets; market research on VSK technology	• Archaic technology • Limited capacity to evaluate new technology or to retrofit existing kilns to reduce manufacturing costs • Heavy dependence on manual labor • Investment for technology upgrade as compared to investment in current technology is significantly higher	• Several potential markets for industrial grade lime, insulates the cluster from individual market demand variations • Potential for improvement in existing kilns through technology development to produce industrial grade lime	• MSME Policy of Government of Tamil Nadu identifies lime manufacturing as a sector under Mining and quarrying, which is ineligible for government subsidies for micro and SSI • Growing decorative paint market and its impact on diminishing white washing market (low prices of product as compared to manufacturing cost)

SUGGESTIONS FOR IMPROVEMENT IN THE CLUSTER

- Investments for the present
    - Retrofit Options for reducing fuel consumption and product quality
    - Development of local fabrication units to meet the requirements of the cluster
    - Minimum testing facilities for quality testing (limestone, charcoal and lime)
    - Collective procurement for insulating cluster from price variations (charcoal and limestone)
- Investments for future
    - Support for implementation of a pilot project with VSK to demonstrate the feasibility for use with crystalline lime stone

1. ABOUT THE PROJECT

1.1 PROJECT OVERVIEW

Small Industries Development Bank of India (SIDBI) and Bureau of Energy Efficiency (BEE) are jointly implementing a Global Environment Facility (GEF)/World Bank funded project, which aims at promoting energy efficiency in Micro, Small and Medium Enterprises (MSMEs) in five clusters viz Ankleshwar Gujarat), Faridabad (Haryana), Kolhapur (Maharashtra), Pune (Maharashtra) and Tirunelveli (Tamil Nadu).

Development Environergy Services Ltd., formerly Dalkia Energy Services Limited (DESL) has been assigned to provide project development support for two of the aforementioned clusters- Faridabad and Tirunelveli.

1.2 PROJECT OBJECTIVE

The objective of the World Bank funded project is to

- To create increased demand for EE investments by adopting a cluster approach to facilitate the development of customized EE products and financing solutions in five targeted industry clusters, and to build the capacity of identified apex organizations to assist MSME units in identifying additional EE projects in the future thereby aiding in widespread replication.
- To raise the quality of EE investment proposals from a technical and commercial perspective , and thus to increase the capacity of both the project developers and bank loan officers/ branch managers to help shrink the gap between project identification and successful delivery of commercial finance.
- To expand the use of guarantee mechanisms for better risk management by banks to catalyse additional commercial finance for energy efficiency
- To establish a monitoring and evaluation system for targeted clusters.

1.3 MAJOR COMPONENTS AND ACTIVITIES OF THE PROJECT

For meeting the overall objectives stated above, SIDBI has engaged the services of DESL for carrying out the following

- To conduct walk through energy audits of a minimum of 400 MSME units in order to assess the feasibility of cost effective low/medium investment oriented energy efficiency projects in the Faridabad and Tirunelveli clusters
- To provide information to MSME's, Financial Institutions and allied stakeholders on the scope for enhancement in energy efficiency through
- Preparing an investment grade detailed project report for the MSME unit to help obtain loan for implementation, if the unit so desires
- Implementation support to the unit including procurement support, assistance as may be required for implementing the selected energy cost reduction measures, measurement and verification of actual savings

2. METHODOLOGY

2.1 METHODOLOGY

For the Tirunelveli cluster the methodology adopted for cluster profiling was as follows:

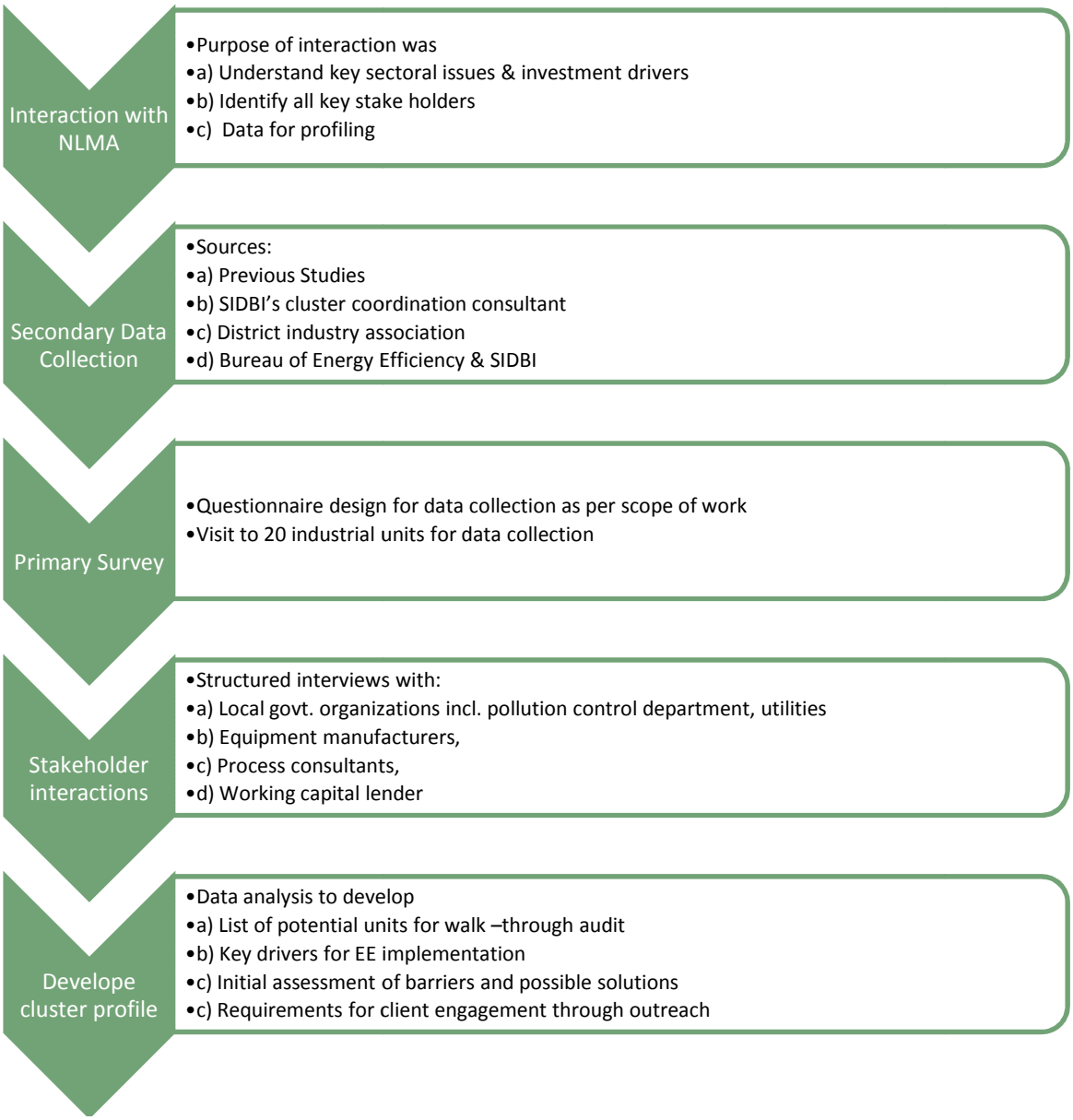


Figure 1 : Methodology for Cluster Profiling: Tirunelveli

2.2 SOURCES OF DATA

The main sources of data for this report include the following:

Table 2 : Main Sources of Data (partial list)

Source of Data	Information Received
ZESPL (Cluster Coordination Consultant) (From SIDBI)	Report on Sector Break up Study for Tirunelveli Limekilns Cluster, Tamil Nadu Report on Capacity Building Needs Assessment for Tirunelveli Limekilns Cluster, Tamil Nadu Report on Selection Criteria for Short listing MSME Units For Conducting Energy Audit Study at Tirunelveli Limekiln Cluster Report on Service Providers and Vendors Supplying EE Technologies for Tirunelveli Limekilns Cluster, Tamil Nadu Database of BEE Certified Energy Auditors Active in Tirunelveli Limekilns Cluster, Tamil Nadu Report on Lending Schemes/Financial Schemes/ Credit Facility/ EE Schemes of SIDBI for Tirunelveli Limekilns Cluster, Tamil Nadu Report on Formation of Cluster Coordination Committee for Tirunelveli Lime Kilns Cluster, Tamil Nadu Report on Profile of Cluster Coordination Committee Members For Tirunelveli Limekilns Cluster, Tamil Nadu
Past Studies	Background Material for Performance Improvement in Small Scale Lime Kilns, Regional Workshop, Tirunelveli, June 2006 (From NLMA) Market Assessment for Energy Efficiency Interventions at SME Clusters in India; July 2008; Winrock International India (From World Bank) Database of Primary SME Clusters for Energy Efficiency Interventions in India, July 2007; Winrock International India (From World Bank) Manual on Energy Conservation Measures in Limestone Clusters in Jodhpur, March 2011, Prepared by CII for BEE (on public domain)
State Government Related (on public domain)	Invitation of tender for the Project: —Development of SME clusters among Lime kiln Manufacturing Units - Power Optimizer; Tamil Nadu Electrical Inspectorate, State Designated Agency for Energy Conservation; January 2011 Annual Reports of Department of Industry; Department of Geology and Mines, Government of India Documents of the Tamil Nadu Pollution Control Board; Minutes of Public Hearing Conducted on 18-05-2011 for existing limestone mines of M/s Krishna Mines Ramayanpatti Village, Tirunelveli TANGEDCO : Tariff applicable for limekilns
Technical Literature (on public domain)	Vertical Shaft Lime Kiln Technology; United Nations Centre for Human Settlement; 1993

Source of Data	Information Received
	Literature from Practical Action • A Small Lime Kiln for Batch and Continuous Firing – Construction Details and Evaluation of Experimental Kiln • How to Build a Small VSK : An Example of a Continuous Production, Mixed Feed Kiln from Zimbabwe • How to calculate the Energy Efficiency of your Lime Burning Process • Case Study in Lime Production No.2; Improved Techniques at Chenkumbi, Malawi. 4 TPD, Mixed Feed, Forced air, Vertical Shaft Kiln Understanding Lime Calcination Kinetics For Energy Cost Reduction; Wicky Moffat and M. R. W. Walmsley; Presented at the 59th Appita Conference, Auckland, New Zealand 16-19 May 2006 Low Temperature Calcination Rates of Limestone ; Archie Wakefield & Mark Tyner Fundamental Approach To the Design of Single Vertical Shaft Lime Kiln; Okonkwo P.C1 , Adefila S.S2, Beecroft G.A3 Department of Chemical Engineering, Ahmadu Bello University Zariam, Nigeria The Kinetics of Calcination of High Calcium Limestone P. C. Okonkwo, S. S Adefila Department of Chemical Engineering, Ahmadu Bello University, Zaria Nigeria; Strategies for Operations of Vertical Shaft Kilns P. C. Okonkwo Department Chemical Engineering. Ahmadu BeIlo University Zaria, Nigeria. S.S Adefila Department Chemical Engineering. Ahmadu BeIlo University Zaria, Nigeria Small Scale Production of Lime for Buildings, John Spiropoulous; 1985 (GTZ) Can Building Lime Produced on a Small-Scale Be More Sustainable? By Peter R M Bartley Review calcination and carbonation of limestone during thermal cycling for CO_2 sequestration; B.R. Stanmore, P. Gilot*
Others (on public domain)	Environment Guidance Manuals for Lime Kilns; ASCI, March 2011 (RPCB)
Primary Survey	Visit to industries (List as per Annex-1) Meetings • DIC, Tirunelveli (Mr Raja Rajan, General Manager) • Pollution Control Board, Tirunelveli (Mr Alwin, Assistant Engineer) • Dept of Mines (Mr Selvasekaran, AD, Mines) • VOC College (Dr Verabhagu, Principal) • Indian Overseas Bank (Mr Ramsubbu, Manager) • Fuel Dealers (Biomass-Mr Ramaswamy and Coal- Suncol, Tuticorin) • Process Equipment Manufacturers (Several) • 2 industries operating with VSK in the region

3. CLUSTER SCENARIO

3.1 INTRODUCTION

Limekiln industries in the MSME sector in India, including the one in in Tirunelveli, Tamil Nadu have been the focus of technical assistance activities (energy related) since lime production is an energy intensive operation. The cluster operates using improvised versions of traditional country kilns, and predominantly serves the whitewashing segment. Even though the cluster has the distinct advantage of being located in a region having high demand for industrial grade lime, this market is not being tapped due to technological constraints (discussed further in this report).

3.2 OVERVIEW OF CLUSTER

GEOGRAPHIC LOCATION[1]

Tirunelveli District, located in southern Tamil Nadu, has a geographical area of 6759 sq.kms, and is flanked by Virdhunagar District in the North, Kanyakumari in the south, Tuticorin in the East and Trivandrum & Quilon districts of Kerala State on the West.

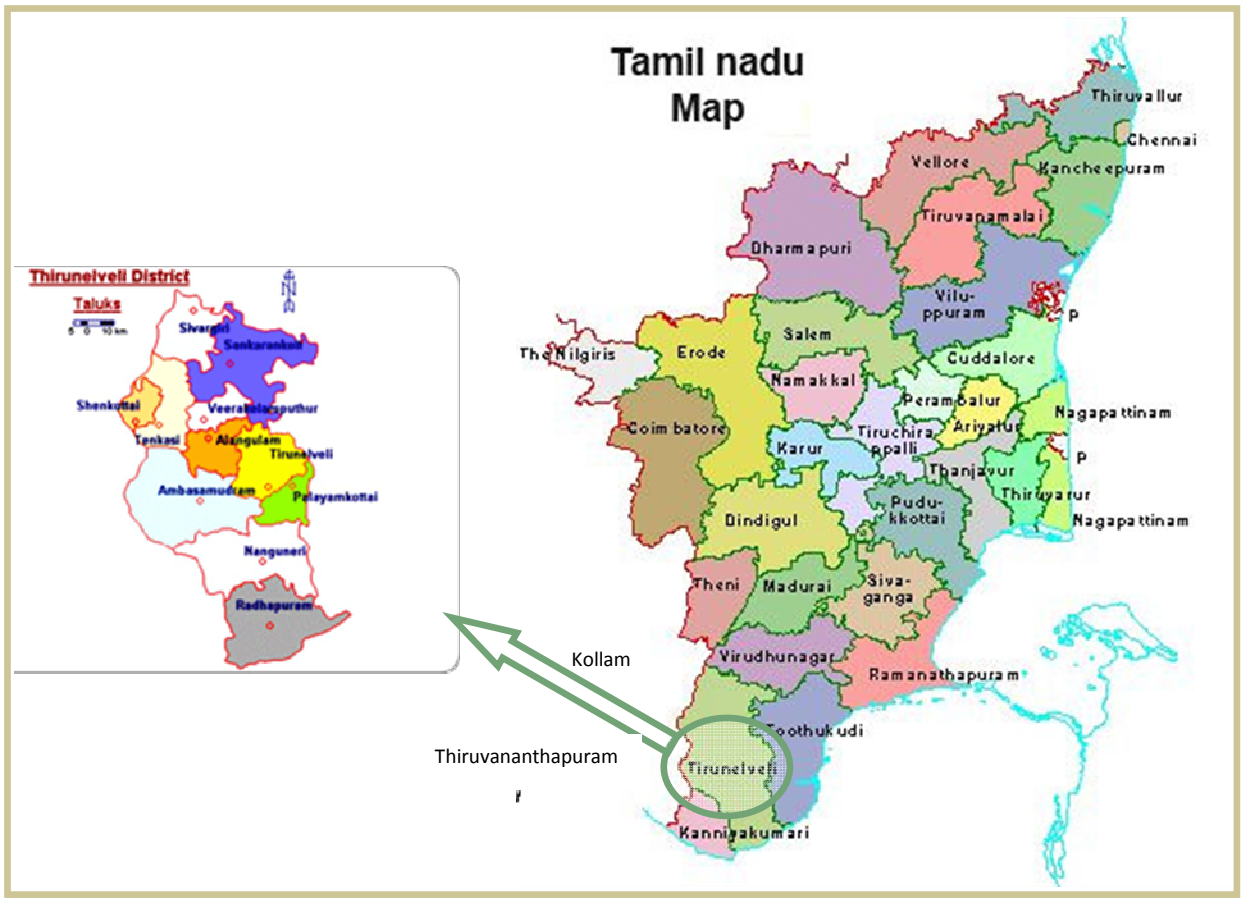


Figure 2 : Location of the Cluster

[1] Source: www.nellai.tn.nic.in

There over 15340 industries in the district spread over 6 industrial areas[2]. Out of this only 15 industries are in the medium and large scale category and the remaining are in the small scale. The district has a well developed infrastructure. However, in the recent past (last 2 years), the power situation has been deteriorating which has impacted industrial productivity.

HISTORY AND EVOLUTION

Tirunelveli is well endowed with minerals like limestone and according to state estimates the production of limestone in 2010-11 was 1230054 MT[3]. Limestone is available in Rastha, Thalaiyoothu, Sankarnagar & Padmaneri. The region has been traditionally producing lime for over 3 decades. A few units are reported to be under construction. While some of the units are self owned and operated, a few of them are leased.

INDUSTRIAL STATISTICS

The statistics on number of industrial units in the cluster according to the state government is as follows:

Table 3 : Details of Lime Based Industries in Tirunelveli[2]

Location	Manur, Alankulam
Major Items manufactured	Burnt Lime, Cem Lime, Dolomite powder
No of units (Micro/Small)	65 Micro & SSI units
No of units (Medium & Large)	Nil
Production (Rs. Crore)	9
Employment (Numbers)	480
Export(Rs. Crore)	Nil
Remarks	Moderate Cluster.

INVENTORIZATION OF UNITS WITH CAPACITY/AGE IN TERMS OF SCALE

The following lists provide as Annex to this report provide a partial listing of the units in the cluster, based on information collected from several sources.

- Annex-1 : List of Units Surveyed, based on references provided by the Association (20 Nos)
- Annex-2 : List of Units Registered with DIC (18 Nos)
- Annex-3: List of Units Registered with the TNPCB (65 Nos)

Classification by capacity would require a primary survey of all units. According to the "Report on Sector Break up Study for Tirunelveli District Lime kIlns Cluster, Tamil Nadu", April 2012, prepared by ZESPL, the cluster coordination consultant, the cluster has 79 industries with 192 kilns and a total installed capacity of 380 TPD. According to discussions with Association[4] the operating capacities range from 4-10 TPD per industry and annual production by the cluster is about 150 TPD (55,000 TPY) against an installed capacity of 300 TPD.

The operating capacity and capacity utilizations of units surveyed by DESL are as follows.

Table 4 : DESL Survey of Industries

Parameter	Unit	Value
Number of Units Surveyed	#	20

[2] Source : http://www.mseclusters-tn.com/mapdetailscodes/includes/district.jsp?StateId=23
[3] Brief Industrial Profile of Tirunelveli; MSME Development Institute, Tamil Nau, 2012
[4] DESL team meeting with NLMA members Mr Kasibabu (Mineral Industries) & Mr N Ravinthiran (JPR Industries) on 16-July-12

Parameter	Unit	Value
Total Installed Capacity	TPD	495
Operating Capacity	TPD	249
Average Capacity Utilization	%	50.4

Unit wise installed capacity, operating capacity and capacity utilization is given in the figure below:

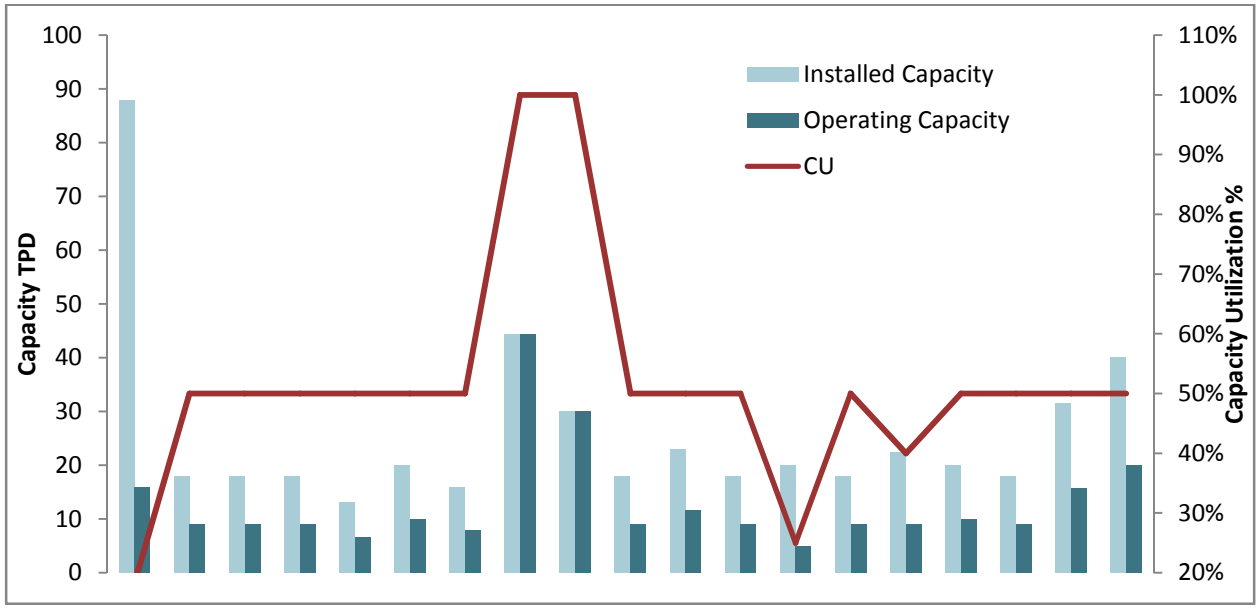


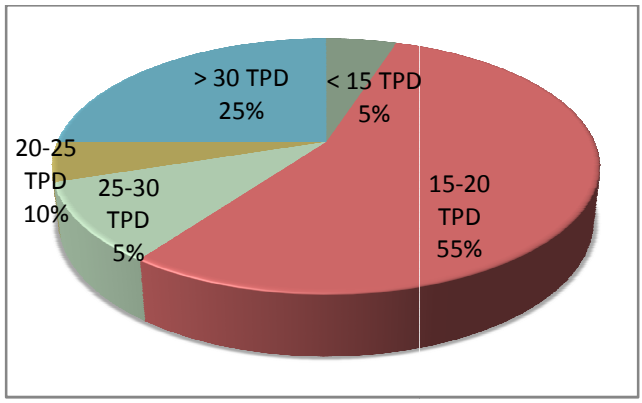
Figure 3 : Capacity of Units Surveyed

The installed capacity ranges between 13 TPD and 18 TPD and individual kiln size between 3 TPD and 15 TPD. Disaggregation for the 20 units surveyed is as follows:

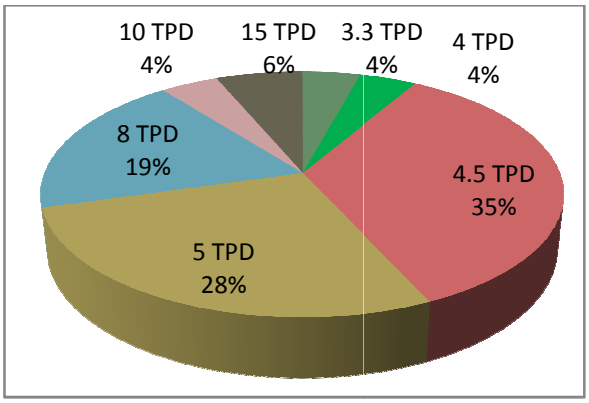
Table 5 : Disaggregation by Capacity and Kiln Size

Parameter	Unit	Value
Number of units based on Installed Capacity	#	
- < 15 TPD		1
-15-20 PD		11
-20-25 TPD		2
-25-30 TPD		1
>30 TPD		5
Number of Kilns in the 20 Units	#	95
- Capacity : 3.3 TPD/ Kiln		4
- Capacity : 4 TPD/Kiln		4
- Capacity : 4.5 TPD/Kiln		33
- Capacity : 5 TPD/Kiln		26
- Capacity : 8 TPD/Kiln		18
- Capacity : 10 TPD/Kiln		4
- Capacity : 15 TPD/Kiln		6

The above data is graphically represented as follows:



Installed Capacity of Units Surveyed



Kiln Size Distribution

Figure 4 : Kiln Capacity and Size Distribution

Data available in public domain is not adequate to provide an age wise grading. According to the discussions with the association[4], the vintage of the kilns range from 32 years to 2 months; 2 more kilns are under construction. The Tamil Nadu Pollution Control Board has also informed that the Consent to Establish has been provided to 4 units in 2011 and 2 units in 2012.

The age profile of the 20 units surveyed by DESL is given below:

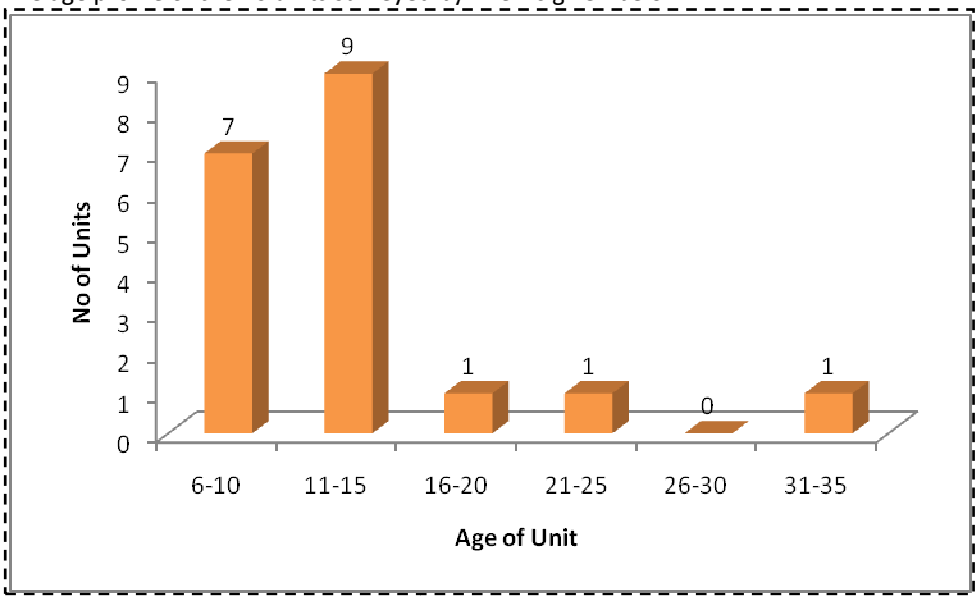


Figure 5 : Age Profile of 20 units surveyed

RAW MATERIAL USAGE IN CLUSTER

The main source of raw material is 2 private lime quarries, Sri Krishna Mines and South India Mines. However since the Sri Krishna Mines have turned captive, the industries in Tirunelveli are almost entirely dependent on South India Mines. There are also small individually owned mines (*thaniyaaru*) which also serve as source of raw material.

Cement industry rejects are mainly purchased by the kiln owners. In 2008, there were issues in availability of limestone from local quarries which prompted the units to explore other options for sourcing of better grade limestone.

Alternative sources for calcitic stone having > 90% $CaCO_3$ in the size range of 20-25 mm are

- From the Middle East (Oman, Qatar and Dubai @ Rs 15 per kg)
- From South East Asia (Vietnam and Malaysia @ Rs 16.50 per kg)

The lime procured from outside the state are of the calcite grade with prices comparable to the price of calcite from local mines[5].

The issue of limestone availability is considered a threat by some of the units; however according to the DIC, it is understood this is not an issue. Analysis of the grades of limestone available is included as Annex-4.

PRODUCTS MANUFACTURED IN MSME UNITS

The industries manufacture dry hydrated lime or lime putty from dolomitic lime stone.

TECHNOLOGICAL UPGRADES UNDERTAKEN IN THE RECENT PAST

In the existing kilns, there is evidence of any concerted efforts being made at unit level or at institutional level to help these industries improve efficiency of existing operations (based on initial discussions, to be validated in subsequent phases of this assignment). The migration to vertical shaft kiln technology is viewed as the technology alternative to existing operations. Two of the units visited have installed vertical shaft lime kilns; as per details below:

Table 6 : Details of Technology Upgrades in the recent past

Detail	Metro coat	LKC
Model	Jodhpur -Rajasthan	Trichy
Capacity	150 tons	10 tons
Year of Installation	2007	2008
Height	45 feet	20 feet
Dia	20 feet	7 feet
Draft	Natural	Forced
Blower capacity	NA	2 HP
Feeding system	Belt conveyer	Bucket conveyer
Kiln feeding	Layering	Spreading
Fuel	Coal	Charcoal
Yield %	65%	50%
Raw material: fuel Ratio	02:0.75	NA

Due to technical difficulties (non-suitability of stone for operation with vertical shaft, feeding of fuel and stone) and product quality issues, these kilns are not in use. The Association is very keen on implementing a pilot project using vertical shaft technology.

DESL also visited 2 units in Tuticorin which are operating lime kilns with limestone sourced from quarries in Tirunelveli.

[5] Price of dolomite from local quarries is Rs 0.6-0.7 per kg and that of calcite is Rs 1-1.2 per kg

Figure 6 :Medium Sized Plants Engaged in Lime Manufacturing

The first unit procures raw material from Valiur (60 Km from Tirunelveli); having CaCO3 content of 83%. High CaCO3 content (> 90-95%) raw material is recovered construction waste. The 2 stones are crushed and blended for calcination. A coal gasifier is integrated to provide heat required for calcination. The slaked lime powder has 70-75% Ca(OH)2 content and is sold to paper, paint and copper industries.

In the second unit, limestone obtained from Valiur is blended with imported stone (Middle East, having CaCO3 content > 95%). The plant and machinery are similar to what is installed in GRT Chemicals. Slaked lime powder has over 90% Ca(OH)2 content and is sold across the state.

CURRENT MARKET SCENARIO

In general the demand for lime is in the following industries

- Building Construction Sector: As a binder for bedding bricks and blocks in wall construction; (however it is being increasingly replaced by Portland cement). It is also used to produce whitewash - the inexpensive wall coating which acts as a primer for dry distemper. It is also used to kill germs because of its alkaline nature.
- Tanneries : Production of alkalis (approx 150 kg per ton of hide)
- Sugar Industries: Addition of lime milk to crude sugar extract to allow the insoluble compounds. Typically the requirement is 15 kgs per ton of sugar produced
- Chemical Industries: Production of caustic soda. Lime is also used to prepare precipitated Calcium Carbonate which is used as a filler material for paper, paint, rubber and in pharma industries. Acetylene gas and calcium cyanide fertilizers are made from calcium carbide, which in turn is made from lime and coke.
- Textile Mills
- Metallurgic Industries: Used in steel making plants to form the flux which carries away the impurities such as slag. Also used with caustic soda in aluminum melting. Lime is used for preparation of non-ferrous metals by the floatation of their ores, acting as a settling agent to control the acidity during the process.
- Water and Sewage treatment Plants : treatment of raw water with lime to reduce the acidity in water and clearing cloudy suspensions
- Agriculture Sector : as a neutralizing agent for soils affected by acidity

The market scenario would therefore be a function of the demand from the above sectors. The scenario in Tamil Nadu for these sectors is as follows.

- There are over 700 tanneries in Tamil Nadu, located around Chennai, Ambur, Ranipet, Vaniyambadi, Trichy, Dindigul. The leather industry in the state accounts for 60% of production in India and 40% of exports by the sector. (Source : Indo-Italian Chamber of Commerce and Industry estimated; 2008)

- Tamil Nadu produced nearly 1.6 million tons of sugar in the 2011-12 crushing season (20% increase over previous year (ISMA Estimates on 30-Apr-12)
- Chemical Industries : The southern districts of Tamil Nadu have several large chemical industries such as fertilizer, chlor alkali etc.
- Textile Industries : Over 900 industries in the state having the capacity to produce 9 million metres of fabric. In Tirunelveli alone; there are over 15 medium to large textile industries.

It is therefore evident that multiple buyers offer the cluster the opportunity to protect itself from demand variations of the respective markets. However, due to technological limitations; the cluster is now catering only to the coating and water treatment segment. In these segments, the demand for lime is high during the period of September to January (coinciding with Diwali and Pongal and post harvest).

TURNOVER AND EMPLOYMENT

The estimated turnover of the industry is Rs 9 Crore and employment is to 480 persons (Table 3)[6].

Availability of casual labor is a major issue in the cluster which is very labor intensive. However due to seasonal nature of the demand and limited capacity utilization, sometimes labor is not available when needed, impacting production.

ENVIRONMENTAL ASPECTS IN THE CLUSTER

Sources of air pollution in the cluster are air pollution caused by lime burning. Most of the kilns in the Tirunelveli lime kiln cluster are open at the top with no provision to control emissions to the atmosphere. A few units have installed chimneys as per requirements of the pollution control board. No survey has been carried out by the TNPCB on the pollution impact of limekilns, since the units are very small, operate seasonally and the cost of such a survey by the TNPCB is passed on to the industries. Based on discussions with TNPCB it is understood that there is a limited visibility due to the suspended particulate matter at the beginning of the charge cycle (1-1.5 hours a day); however; on an overall 24 hour basis. List of units in the cluster which are operating with CTO or CTE is included as Annex-3.

SOCIAL ASPECTS IN THE CLUSTER

Employment in the cluster is mostly of unskilled labor. A typical unit operating 1-2 kilns a day has 2-3 laborers under a supervisor. Wages, paid based on current labor law requirement also indexed to output. Some of the larger units have provisions for employee welfare. Most of the skill upgradation is through experiential learning.

[6] Based on discussions with DIC it is understood that the units are required to voluntarily file Form 17-A. Very few units comply with this. The price of whitewash has increased from Rs. 2.50/kg in 1995 to Rs 5-7/kg at present.

4. MAJOR CLUSTER ACTORS

4.1 Industrial Association

The Tirunelveli (District) Lime Manufacturers Welfare Association, represents approximately 50% of the industries in the cluster. The President of the Association is Mr. N. Mariappan (Prop. Natarajan Lime Industries and Arasan Chemicals), and the General Secretary is Mr R. Gomathinayagam (Prop. Saravana Chemicals).

4.2 Government Bodies Associated With MSME's In The Cluster

The main state government bodies associated with the cluster are the following:

a) The District Industries Centre; Department of Industries & Commerce
b) The Department of Mines
c) The Tamil Nadu Pollution Control Board

The District Industries Centre (DIC) is a state government organization under the Department of Industries providing facilitation services to industries in the District. The DIC is responsible for guiding enterprises, coordinating the issue of Part-I and Part II acknowledgment to MSME's, granting incentives, issue of Entrepreneur Memorandum acknowledgement, serve as a single window clearance to obtain clearances from other departments, rehabilitation of MSME's, implementation of quality control order and providing escort services.

The Department of Mines under the Commissioner ate of Geology and Mining of the state government is in charge of mineral administration. The role of the department includes exploration, grant of licenses and administration of leases/commissions granted.

The Tamil Nadu Pollution Control Board's district office's role is to work towards the Board's objective of controlling, preventing g and abating pollution of streams, wells, land and atmosphere in the State and protecting the environment from any degradation by effective monitoring and implementation of pollution control legislations. The main role in the context of the cluster in focus are to provide consent to establish to new industrial units and consent to operate to existing units as per provisions of pollution norms in the state.

4.3 Academic & R&D Institutions

The Cluster Coordination Committee includes a representative from the Department of Geotechnology of the Manomanian Sudaranar University in Tamil Nadu. The University has a fully equipped remote sensing and GIS laboratory which is accessible for survey of mines and testing of limestone. At a national level the Central Building Research Institute, Roorkee have carried out R&D in small scale lime kilns[7], however has no linkage to the Tirunelveli cluster. However, no known technology development linkages are available to the cluster.

4.4 Service/Technology Providers

For the scale of operations presently in place in the clusters there are no known service or technology providers. Based on DESL's discussions with several members of the association it is understood that the kiln itself is constructed by the owners themselves. Other equipments such blowers, crushers and pulverizers are being procured locally.

4.5 Financial Institutions/Banks

[7] Consultants team have contacted CBRI and the National Research Development Council, it is understood that no R&D work has been done for the last decade.

The Lead Bank responsibility in the district lie with the Indian Overseas Bank[8] and the Tamil Nadu Industrial Investment Corporation (TIIC)[9].

Table 7 : Lead Bank Details in Tamil Nadu

Lead Bank	Contact Details
Indian Overseas Bank	131, East Car Street, Tirunelveli Town Tirunelveli– 627006 Ph: 462 2321012
Tamil Nadu Industrial Investment Corporation (TIIC)	5B/5C, Sakunthala Shopping Complex 2nd Floor, Vanarapettai Tirunelveli 627 003. Ph: 462-2502038

Details of other banks and financial institutions with presence in Tirunelveli include:

Table 8 : Details of Other Banks in Tirunelveli[10]

Name of Bank	Number of Branches
Indian Overseas Bank	19
Pandyan Grama Bank	20
Canara Bank	8
State Bank of India	5
ICICI Bank Ltd.	4
Tamil Nadu Mercantile Bank	3
Central Bank of India	1
Indian Bank	1
Lakshmi Vilas Bank	1

The main bank involved in financing the lime kiln sector is the Tamil Nadu Industrial Investment Corporation Ltd[11]. The Indian Overseas Bank is a member of the Cluster Coordination Committee; however the exact number of borrowers from lime kiln sector was not available from the Bank.

[8] Source: http://rbidocs.rbi.org.in/rdocs/PublicationReport/Pdfs/ANN280809_1.pdf
[9] Source: http://www.msmedi-chennai.gov.in/MSME/Tirunelveli.jsp
[10] Source: http://www.nellai.tn.nic.in/lead_bank.pdf
[11] Based on discussions with DIC; TIIC is also reportedly satisfied with performance of the units in this cluster.

5. TECHNOLOGY USED AND PRODUCTION PROCESS IN CLUSTER

5.1 Technology Used in the Cluster

The lime burning technology used in the cluster is that of a conical kiln ending with a stemless funnel type section and designed to handle mixed feed. Typically these kilns have an open top and the kilns are constructed with local materials (brick and mortar, in some cases lined with fire bricks).

Firebrick walled Kiln

Conventional Construction

Figure 7 : Lime Kilns in Tirunelveli

5.2 Manufacturing Process

The process flow diagram in a lime manufacturing process is depicted below:

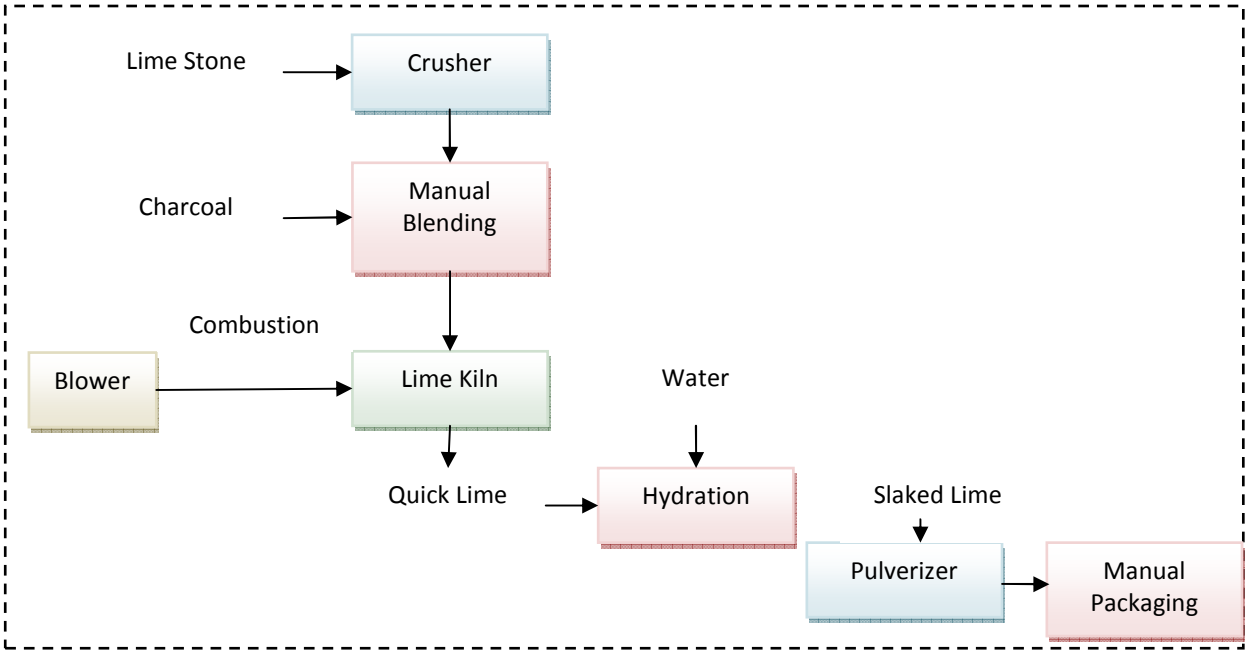


Figure 8 : Process Flow Diagram

Country kilns are cylindrical and vary in size (2.5 TPD to 15 TPD, in the units surveyed by DESL). These kilns called “ulai” (in local language) dimensions are as follows : height above surface is 2.5-3m, height below surface : 0.5m & diameter : 2.5 to 3 meters. Near the bottom on the conical section, there is a single inlet for air supply. A blower (3 HP Motor) supplies air from bottom of the kiln to enable calcination. The kiln is constructed with low cost local materials like clay bricks, boulders etc. and with mud as mortar. Limestone (12 to 19 mm size) and fuel are mixed manually and fed in to the kiln and firing is started. The cycle time for a single batch is 12-14 hours. Quick lime powder is removed from outlet at the bottom of the kiln.

Prior to charge, raw material received is crushed in a jaw crusher (50 HP Motor). The range of stone size that can be handled by the crusher is 9”-12”

Slaked lime is pulverized and then packaged. Pulverization process helps in removing rejected and unburnt material (typically 20-25%).

5.3 Equipment Description

JAW CRUSHER

A jaw crusher is installed in raw material storage area and is used for material size reduction. Jaw crushers are used as primary crushers, or the first step in the process of reducing rock. They crush primarily by using compression. The rock is dropped between two rigid pieces of metal, one of which then moves inwards towards the rock, and the rock is crushed because it has a lower breaking point than the opposing metal piece. Jaw crusher can crush large-sized limestone, and the range of size that can be handled by the crusher is 9-12”. The crushers are operated intermittently depending on the kiln charging plan

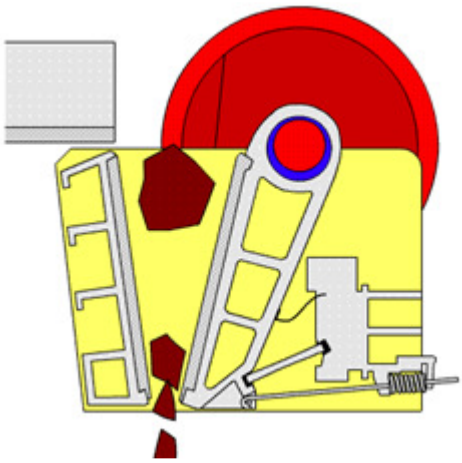


Figure 9 :Jaw Crusher

LIME KILN

Country kilns are cylindrical and vary in size. These kilns called “ulai” (in local language) dimensions are as follows : height above surface is 2.5-3m, height below surface : 0.5m & diameter : 2.5 to 3 meters. Near the bottom on the conical section, there is a single inlet for air supply. A blower supplies air from bottom of the kiln to enable calcination.

The kiln is constructed with low cost local materials like clay bricks, boulders etc. and with mud as mortar. Limestone (12 to 19 mm size) and fuel are mixed manually and fed in to the kiln and firing is started. The cycle time for a single batch is 12-14 hours. Quick lime powder is removed from outlet at the bottom of the kiln.

AIR BLOWER

A blower installed in the kiln and is used for supplying the combustion air. **Centrifugal** fans or blowers normally mounted in a fan or blower housing. The air enters the housing inlet, is turned 90 degrees and is exhausted out of the housing discharge

Each kiln has 1 blower operating approximately 12-14 hours per day.

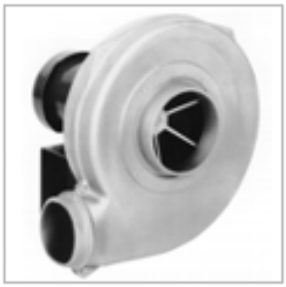


Figure 10 : Blower

PULVERIZER

A Pulveriser is installed in the packaging area and is used for pulverizing the slaked lime to 300 to 325 mesh size. The Pulveriser operates by impact action and will pulverize most dry, free-flowing materials. Material fed into the hammer mill from the top falls into the grinding chamber. The material is contacted by a series of hardened steel hammers rotating at high speed. The material is ground by repeated contact with these hammers, contact with the walls of the grinding chamber, and particle to particle contact. The material remains in the hammer mill grinding chamber until particles become small enough to escape by passing through the perforated screen that covers the bottom half of the grinding chamber. Interchangeable hammer mill screens are available with hole diameters from 1/64" to 2", to allow for fine or coarse grinding of most products. Size reduction is caused by impact between the rotating hammers, particles and deflector liner mounted in the mill housing cover. The desired fineness can be influenced by the type of hammer, rotor speed and the size of the screen opening.

Figure 11 : Pulverizer

6. ESTIMATED ENERGY CONSUMPTION PATTERN IN CLUSTER AND SAVING POTENTIAL

6.1 Sources of Energy & Consumption

The primary energy used in the lime kilns in Tirunelveli are:

a) Charcoal
b) Electricity

Out of 20 units surveyed by DESL, 2 units have provision for backup power supply with DG based operations. Details of energy consumed (both charcoal and electricity) and prices are discussed in the following sections.

6.2 Charcoal Usage

The main source of fuel in the Tirunelveli cluster is wood based charcoal. Charcoal used locally was analysed for fuel characteristics and results of analysis are as follows. The gross calorific value of the sample was 5649 kCal/kg.

Table 9 : Characteristics of Charcoal – Sample tested from Local Kiln by DESL[12]

Ultimate Analysis	Value	Ultimate Analysis	Value
LOI%	51.02% W/W	Carbon	33.88%
Density	1.86 g/cc	Hydrogen	3.86%
Moisture	27.21%	Oxygen	25.8%
Fixed Carbon	16.24 %	Nitrogen	0.572%
Ash	8.82%	Sulphur	0.16%
CaO in Ash	42.3%		
SiO_2 in Ash	10.2% W/W		

There are several local suppliers of fire wood and charcoal. The price in the last 2 years has ranged between Rs 10-15 per kg[13]. Several fuel alternatives exist, such as coal from Tuticorin; biomass briquettes (from Erode at Rs 6/kg landed price), coir residues, coconut shell (from Tuticorin and Erode at Rs. 5.0 per kg landed price), ground nut shells etc.; however replacement of charcoal with another fuel has to take into consideration impact on product quality.

Due to intermittent, batch operations, correlation between charcoal used and capacity utilization cannot be established.

Charcoal consumption per kg of lime produced in the units surveyed by DESL is as follows:

Table 10 : Charcoal Consumption in Units Surveyed

Parameter	Kg/ton of lime
Average	203.6
Maximum	140.0
Minimum	184.8

The number of units in different bandwidths of charcoal consumption is as follows:

[12] Source : Sample test was done from Ecochem Laboratory Services Division, Chennai
[13] Source: Discussion with several fuel vendors

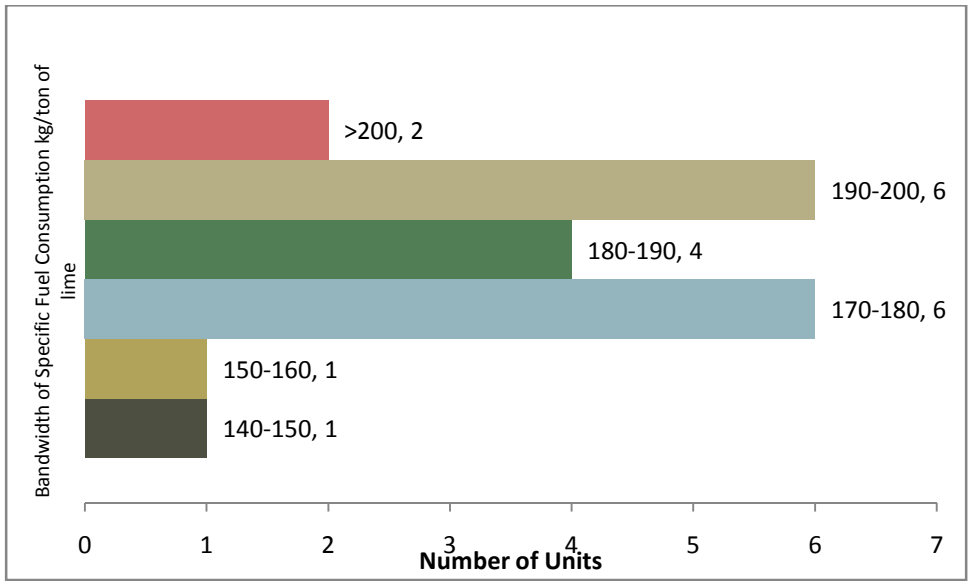


Figure 12: Fuel Consumption by Units Surveyed

At an average price of Rs 13 per kg of charcoal; and manufacturing cost of Rs 4/kg of lime[4]; this is approximately 60% of the manufacturing cost of lime.

6.3 Electricity Usage

Electricity supply in the cluster is from the TANGEDCO (Tamil Nadu Generation and Distribution Corporation Ltd.) The units surveyed have LT Connection and the tariff corresponding to Category III-B of TANGEDCO, for this type of industry is as follows:

Table 11: Tariff Structure

Tariff Component	Charges
Energy Charges	@ Rs. 5.50 per kWh/Month
Fixed Charged	@ Rs 30.50 per kW/Month
Tax on Energy Billed	5%

The main end uses of electricity are the crusher, blower and pulverizer. The electricity consumption in units surveyed is as follows:

Table 12 : Electricity Consumption in Units Surveyed

Parameter	kWh/ton of lime
Average	58.6
Maximum	48.5
Minimum	52.0

70% of units surveyed by DESL have energy consumption ranging between 50-54 kWh/ton of lime. At an average variable cost of Rs 5.78/kWh, the electricity cost is about 7.5% of manufacturing cost of lime.

6.4 Energy Saving Potential

According to review of literature the theoretical requirement for calcinations of pure limestone is 750 kCal/kg of lime. The main losses are as follows:

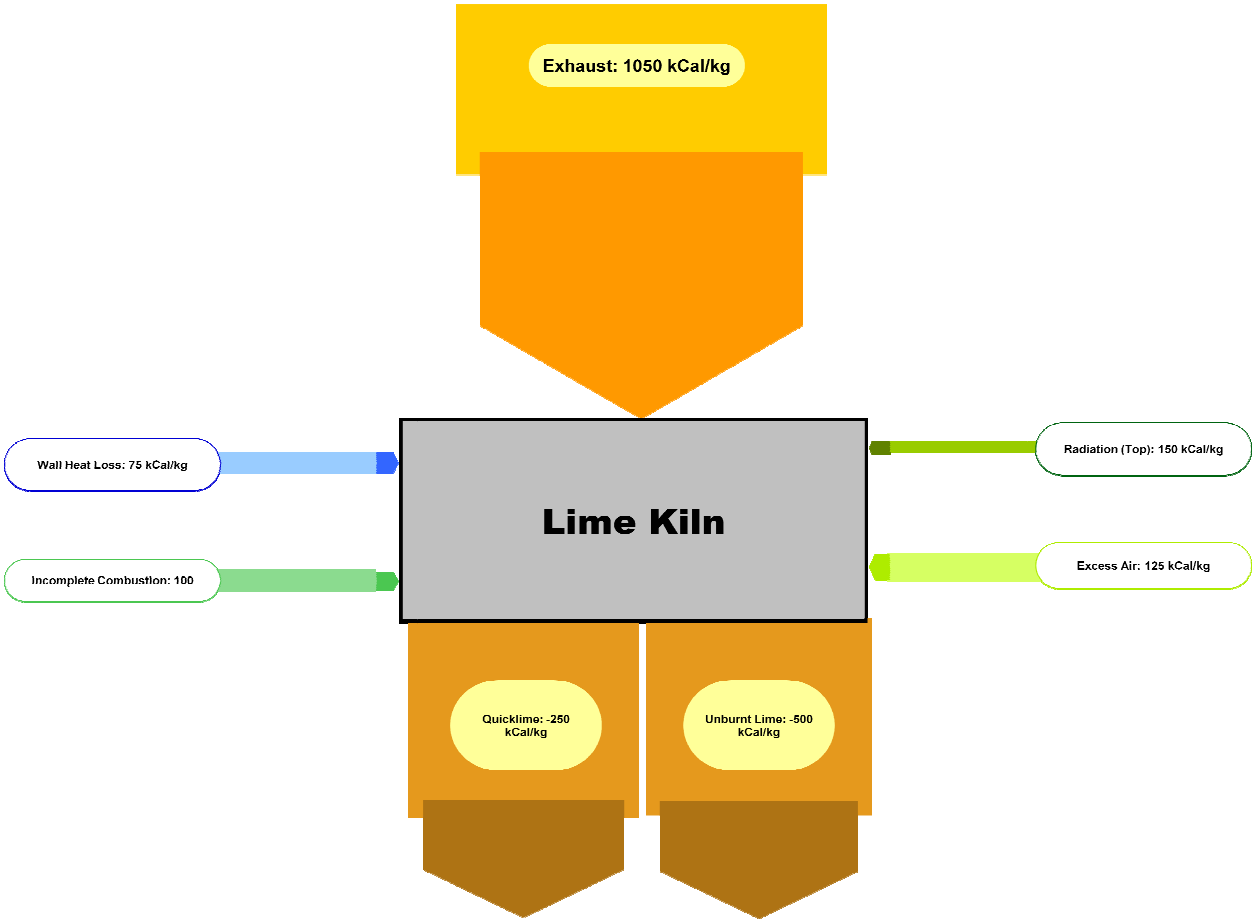


Figure 13 : Typical Heat Losses in a Country Kiln (Source : CBRI)

Efforts made for fuel saving can also impact the product quality and the benefits to the units would therefore accrue from lower cost of production and higher value of sales. The main areas for reduction of losses as observed during the survey are:

- Heat loss from the exhaust
- Reduction in losses during the kiln wall and from the top of the kiln through radiation
- Sensible heat lost with quick lime
- Heat loss due to absence of excess air control and improper combustion
- Heat loss due to over burning

Technology solutions, to reduce losses, (e.g. improved insulation, improved air distribution; use of recuperators, etc.) though demonstrated in other sectors having similar process , have to be adapted and tried for this specific sector. In addition to the above, significant product quality improvement can be achieved through implementation of vertical shaft kiln technology.

The key criteria for selection of units for walk through assessment would be a) from the membership of the Association and b) interest of the unit in the proposed project activities.

7. MAJOR CHALLENGES AND SUGGESTIONS FOR IMPROVEMENT IN THE CLUSTER

7.1 CHALLENGES

- Technology Related
  - The cluster deploys very old type of technology with minimum technology upgrades.
  - Type of lime : Limestone available in the cluster is crystalline, harder than amorphous variety which is available elsewhere in India
  - Almost all technology related interventions in the context of lime kilns
- Energy Related
  - High charcoal consumption : According to the Association, the charcoal consumption is more than 2 times of other clusters
  - Energy cost in total manufacturing cost is estimated at around 67.5%
  - Electricity, though a smaller component of total manufacturing cost (about 7.5%), impacts the quality of product. The power situation in Tamil Nadu is erratic has been deteriorating in the last 2 years. During the calcination process, power is required for the blower. In the absence of power supply, the reject percentage is very high.
- Marketing Related
  - Market being catered to has a seasonal demand
  - The growth in sales value is lower as compared to increase in manufacturing cost[14]
- Raw material and quality related
  - The raw material available to the lime kilns is rejects from cement industries in the district.
  - There are 2 private quarries in the district, of which one has turned captive, limiting the source of limestone. Some of the units have looked outside the state and at imports to solve the problem, however a few units view this as a threat
  - Since the local sources of raw material are limited, and the thin margins, the operations are sensitive to raw material price increase
- Products and their quality related
  - The product manufactured is suitable for meeting whitewashing and water treatment requirements; which is at the lower end of the value spectrum of various grades of lime
  - There is a good indication demand from diverse markets in the region; which is served by competition mostly from Andhra Pradesh and Rajasthan
- Manpower and skills Related
  - Industry is heavily labor intensive with manual operations
  - Due to seasonal nature; sometimes operation is not possible due to non-availability of labor
- Environmental challenges
  - Highly dense pollution during the initial 60-90 minutes of charge, with reportedly high carbon-mono-oxide concentration
  - Poor visibility in the Rastha region, where kilns are located near the main road which has traffic .
- Social Challenges
  - Increase in cost of labor is not commensurate to increase in selling price of product
  - For the same wages; there are other employment options which are less physical labor intensive, which make labor availability an issue

7.2 SUGGESTIONS FOR IMPROVEMENT IN THE CLUSTER

- Retrofit Options for reducing fuel consumption and product quality
- Minimum testing facilities for quality testing (limestone, charcoal and lime)

[14] To be quantified during following phases of this assignment

- Collective procurement for insulating cluster from price variations (charcoal and limestone)
- A notable constraint is the absence of access to technological information and know- how. Even more notable is the very limited technology development focus for small scale lime kiln operations.
- Development of local fabrication units to meet the requirements of the cluster

8. SWOT ANALYSIS

- **Strengths**
  - The main strength of the cluster comes from the years of experience in lime manufacturing and survival and growth despite adverse market conditions
  - Initiatives taken by the Association for solving their various issues, (illustrative areas in list below) is laudable
    - Sourcing of limestone
    - Initiation of cluster level project for large scale lime manufacturing
- **Weaknesses**
  - Technology deployed in the cluster is very old
  - Ability to evaluate new technology is limited
  - Manual labor; migration to a minimum level of automation while keeping production costs low
  - The scale of investment for improved technology as compared to existing technology differs by several orders of magnitude. The units therefore require support to be able to invest in a new technology like vertical shaft kiln which is not entirely risk free.
  - Capacity to carry out feasibility studies before making an investment is limited
- **Opportunities**
  - Several potential markets for industrial grade lime; insulate from market variations
- **Threats**
  - The Micro Small and Medium Industries Policy, 2008 of the Government of Tamil Naidu (GO MS No 14, Micro Small and Medium Enterprises (B) Dept. dated 07.05.2008), identified as Annexure –IV a "List of enterprises/ activities ineligible for incentives". This list includes "Mining and Quarrying" Industries. Lime manufacturing is being regarded as falling under this category and the units are therefore ineligible for incentives available to MSME units in the state
  - From the decorative paint market segment which has highest growth in rural areas, the natural market of the small scale limekilns
  - Dependence on Manual Labor

9. CONCLUSION

The Tirunelveli lime kiln cluster, has been the focus of several technical assistance activity for improvement of energy performance. Even though the turnover of the cluster and the number of industries is smaller than many other clusters in the country; the significance of energy in total cost of production cost is high.

In terms of energy efficiency improvement; most of the recommendations from previous studies are in terms of technology replacement, i.e installation of vertical shaft kilns with gasification systems. While this recommendation has merit of likely improvement of product quality and hence ability to cater to demand of high value segments of the lime product spectrum; there are a number of retrofits which can be designed and implemented in existing kilns. Results from implementation of these retrofits can help in determining the suitability of existing kiln for higher grade lime production.

As an investment for the future, in view of the diminishing market for whitewashing, it is desirable to implement a pilot project for demonstration of vertical shaft kiln technology in the cluster. Due consideration to the following factors is required for success of the demonstration:

a) Suitability of technology for local lime quality
b) Availability of manufacturing capability in the scale of operations (i.e. 10 TPD) targeted by the cluster (most manufacturers offer kilns of minimum 20 TPD capacity)
c) Energy performance i.e specific fuel consumption per unit of product
d) Higher level operation skills required
e) Higher level of investment required and availability of cost effective financing.

10. ANNEXES

Annex 1 List of Units in the Cluster Surveyed

Sl.No.	Name of Unit	Address	Contact Person & Contact No.	Installed Capacity
1	Metro Coat Rajapalayam Pvt Ltd.	1699/3,Gangai Konan Village,SankarNagar,Tirunelveli	Mr. Siva Kumar. S / 9364441499	88 TPD
2	Bharathi Chemicals	351/A,Madavakurchi Road, Tirunelveli	Mr. Raj.I / 944334616	18 TPD
3	Uthra Enterprises	334,Sangarankovil road, Rastha,Tirunelveli	Mr. Thiraviyam.p / 9443130697	18 TPD
4	Sri Raja Ganapathi Lime Products	229/2A,2B,Sangarankovil road, Nariyuthu, Tirunelveli	Mr. B.Jega Jothi / 9942662929	18 TPD
5	Saravana Chemicals	2/339-A,Sankarankovilroad,Rastha,Tirunelveli	Mr. Gomathinayagam R / 9443473510	13.2TPD,
6	Sri Bhuvaneswari	315 , Sankarankovil Road, Rastha, Tirunelveli	Promoter Mariyappan.M / 9486272850	18 TPD
7	L K C Enterprises	165,Sankarankovilroad,Thachanallur Post,Tirunelveli	Owner Shunmuga Sundaram .P / 9443365495	22.5 TPD
8	Sri Ram Chemicals	337,Sangarankovil road, Madavakurchi Post,RasthaTirunelveli	Mr. Shanmuga Sundram.P / 9942662929	20 TPD
9	United Chemicals	II/361,SankaranKovil Road,Madavakurchi ,Rastha, Tirunelveli	Mr. Ramakrisnan.S / 9443972154	16 TPD
10	Archean Granites	3/106, Sankarankovil Road, Sethurayanpudur, Tirunelveli	Mr. EzhilMurugan.T / 9443363077	74.4 TPD
11	Natarajan Lime Industries	81A,Madurai road,Sankarnagar,Tirunelveli	Mr. Mariappan.N / 9443130962,9443190653	18 TPD
12	Mineral Industries	Madavakurchi,Rastha Tirunelveli	Kasi Babu.A / 9843559659	32 TPD
13	New Star Chemicals	336 A, Madavakurchi,RasthaTirunelveli	Mr. Selvi.E / 9843180151	18 TPD
14	Hari Lime Industries	306/1,Nariyuthu,Rastha,Tirunelveli	Mr. Vijayabaskar / 9994881888	31.5 TPD
15	Sri Sivasakthi chemicals	346/1,Madavakurchi ,Rastha,Tirunelveli	Mr. Narayanan / 9442021617	23 TPD
16	Ram Balaji industries	397/2,Madavakurchi ,Rastha,Tirunelveli	Mr.Srinivasan.R / 9442021617	40TPD
17	Sri Lakshmi lime industries	Quarry road, Sangarnagar, Tirunelveli	Mr. S.Siva Kumar / 9360119209	18 TPD
18	Arasan chemical	9/183 K,Thenkalam Road,Thalayuthu,Tirunelveli	Mr. Jamal Maydeen I / 9965530488	20 TPD

Sl.No.	Name of Unit	Address	Contact Person & Contact No.	Installed Capacity
19	Siva agencies	Therkkumalai Colony,Therikalam,Sankarnagar Post,Tirunelveli	Mr. Selvam.S.P / 9443450457	40 TPD
20	Jayalakshmi industries	S.N 4C,SankaranKovil Road, Madavakurchi, Rastha, Tirunelveli	Mr. Krisnamoorthy.K / 9842104836	20 TPD

Annex 2 List of DIC Registered Units

Sl No	Name of the Unit	Registration number
1	Metrocoat	1699/3
2	Melwin Enterprises	5594
3	Murthy Mineral Industry	
4	Siva Enterprises	1536
5	Suriya Enterprises	1598
6	United Chemicals	1938
7	Uma Enterprises	2063
8	Sri ram Chemicals	2116
9	Sri ram Chemicals	217
10	Meoral Enterprises	2573
11	Sri Ramakrishna Industries	1320
12	Sri Ramakrishna Industries	1319
13	Bharathi Chemicals	2921
14	S.S Manian Company	236
15	Arul Industries	3640
16	Krishna Mines	3715
17	Jeyashree Industries	5070
18	Everest Industries	5071

List of Industry Profiles

Category : Orange Type : 2079-Lime Manufacture (Lime kiln) Units Classification : Small

Sl. No.	Industry Name, Address and	Consent issued under CTE/CTO	Source of emission
1	Sudalaimuthu Lime Industries 584, Chittirampudukulam, Tirunelveli Taluk	CTO	KILN
2	Sri Vinayaga Enterprises 401/2A, 2D, Thalaiyuthu Village, Tirunelveli Taluk	CTO	KILN
3	Sofi Enterprises 85/ 2 Thalaiyouthu, Tirunelveli Taluk	CTE	KILN
4	Noora Cem Industries 341 /1, Madhavakurichi, Tirunelveli Taluk	CTO	KILN
5	Sneha Cem Factory 89 /2D2, 391/ 2, 391/ 3, Madavakurichi, Tirunelveli Taluk	CTE	KILN
6	Raja Cem Lime Industries 113/1, Thirupanikarisalkulam, Tirunelveli Taluk	CTE	KILN
7	Pradeepkumar Enterprises 249/2, Madavakurichi, Tirunelveli Taluk,	CTO	KILN
8	R.K. Industries 423 2, 436 4, Madhavakurichi, Tirunelveli Taluk	CTE	KILN
9	M.K.V.K. Chemicals 59-2B8, Kallurani, Tenkasi Taluk.	CTO	KILN
10	Sri Ramakrishna Indusrties 187/1A2, 187/1B2, Madhavakurichi, Tirunelveli Taluk	CTO	KILN
11	Uthra Enterprises 191 1, 191 2A, Mathavakurichi, Tirunelveli Taluk	CTO	KILN
12	Sri Ram Chemicals 4/149 ,Sankarankoil Road, Rastha, Tirunelveli Taluk	CTE	KILN
13	R. K. T. Enterprises 422/ 2A Madavakurichi, Tirunelveli Taluk	CTE	KILN
14	Udayam Minerals 307/1, Part, Madhavakurichi, Nariyoouthu,Tirunelveli	CTO	KILN
15	Taska Cem and Minerals 445/2B, Madhavakurichi, Tirunelveli Taluk	CTE	KILN
16	United Cem Company 183/2, 184/1,2, Madhavakurichi, Tirunelveli Taluk	CTO	KILN
17	Sudhamaa Limes and Calcite Industries 453/1, 453/3-B2, Madhavakurichi, Tirunelveli Taluk	CTE	KILN
18	Rajapalayam Cement and Chemicals Ltd 1078-1, 2, Thenmalai Part - I, Sivagiri Taluk	CTO	KILN
19	Sri Sivasakthi Chemicals 381/2, Madhavakurichi, Tirunelveli Taluk	CTO	KILN

Sl. No.	Industry Name, Address and	Consent issued under CTE/CTO	Source of emission
20	Rathna Traders 381-1, Madavakurichi, Tirunelveli Taluk,	CTO	KILN
21	Saj Chemicals 391/1, Madhavakurichi, Tirunelveli Taluk	CTO	KILN
22	Deen Chemicals 422/B, Madavakurichi, Tirunelveli Taluk,	CTE	KILN
23	Limenaph Chemicals Private Ltd 1322-1, 1322-2, Madhavakurichi, Tirunelveli Taluk	CTO	KILN
24	Siva Lime Industries 1702/3, Gangaikondan, Tirunelveli Taluk	CTE	KILN
25	Sri Selvi Industries 305 1C,1D 292Madhavakurichi Village, Nariyoothu, Tirunelveli	CTE	KILN
26	Sahana Chemicals 86/2, Thalaiyouthuy, Tirunelveli Taluk	CTO	KILN
27	Sankar Chemicals 246/2, Madhavakurichi, Tirunelveli Taluk	CTE	KILN
28	Jannath Cem Industries 444/2A2, Madhavakurichi, Tirunelveli Taluk	CTE	KILN
29	Ananda Constructions 1697/1B, Gangaikondan, Tirunelveli Taluk	CTE	KILN
30	Sri Kumaran Industries 249 2A Madhavakurichi, Tirunelveli Taluk	CTO	KILN
31	M.V.M. Chemicals 291, Kondanagaram, Tirunelveli Taluk,	CTO	KILN
32	Kaveri Chemicals 722/2A, 723, Chatramputhukulam, Tirunelveli Taluk	CTO	KILN
33	Tirunelveli Lime Products 1679/1, Gangaikondan, Tirunelveli Taluk,	CTO	KILN
34	Ramesh Chemicals 177/5, Sethurayanputhur, Tirunelveli Taluk	CTO	KILN
35	Sri Dhana Lakshmi Enterprises 9/183D, Tenkalam Road Thalaiyuthu, Tirunelveli Taluk	CTO	KILN
36	Kamatchi Chemicals R.S. No. 166, Vadikottai, Sankarankovil Taluk,	CTO	KILN
37	Sivapriya Industries 65/16, 65/18, 65/15, Nanjankulam, Tirunelveli Taluk	CTO	KILN
38	Sri Abinava Bharathi Chemicals 194 1B, Madhavakurichi, Tirunelveli Taluk	CTO	KILN
39	Sankar Minerals S No 801 2 Kandiaperi, Tirunelveli Taluk	CTO	KILN
40	Komala Lime Industries 901/A, Naranamalpuram, Tirunelveli Taluk	CTO	KILN
41	Metro Industries 183, Sri Rengapalayam, ,Rajapalayam-626 117	CTE	KILN
42	Saravana Chemicals 192 2, Madhavakurichi Tirunelveli Taluk	CTO	KILN
43	United Chemicals 187/1A, 1B, Madhavakurichi, Tirunelveli Taluk	CTO	KILN

Sl. No.	Industry Name, Address and	Consent issued under CTE/CTO	Source of emission
44	Sri Raju Chemicals Co 229/2A / 2B Madhavakurichi Village, Tirunelveli Taluk	CTO	KILN
45	Bharathi Chemicals 449/2B, Madhavakurichi Village, Tirunelveli Taluk	CTO	KILN
46	Uthayakumar Industries 958 1 Thenkalam, Tirunelveli Taluk	CTO	KILN
47	Muthukumaran Industries 278, 273/1C, Madhavakurichi, Tirunelveli Taluk,	CTO	KILN
48	Archean Granites 186, Sethurayanputhur, Tirunelveli Taluk	CTO	KILN
49	J R V Lime Industries 190-1, Madhavakurichi, Tirunelveli Taluk	CTO	KILN
50	Five Rose Lime and Chemicals 327, Thalayuthu, Tirunelveli Taluk	CTO	KILN
51	J P R Industries 1699-1, Gangaikondan, Tirunelveli Taluk	CTE	KILN
52	Good Nice Cem Factory 80, Thalaiyuthu, Tirunelveli Taluk	CTE	KILN
53	Suriya Enterprises 190-2C, Madhavakurichi, Tirunelveli Taluk	CTO	KILN
54	L K C Enterprises 165, Sethurayanpudur, Sankarankoil Road, Thatchanallur Tirunelveli Taluk	CTO	KILN
55	Melwin Enterprises Mathavakurichi Road, Rastha , Tirunelveli Taluk	CTO	KILN
56	Sri Hari Narayana Enterprises Near Esakkiamman Koil,Sankarankoil Road Rastha, Mathavakurichy P.O, Manur	CTE	KILN
57	Vijayalakshmi Industries 449/2B Mathavakurichi Village, Manur Block , Tirunelveli Taluk, Tirunelveli District	CTE	KILN
58	Krishna Mines 358 Ramayanpatti, Tirunelveli Taluk	CTE	KILN
59	M.S.P.V. Chemicals Unit - II 353, 354, 356-2, Kulasekarapatti, Tenkasi Taluk	CTO	KILN
60	Sri Vinayaga Industries 1185/3A, Thenmalai, Sivagiri Taluk	CTO	KILN
61	Sri Saravana Chemicals 1188/2, P. Reddiapatti Hamlet, Thenmalai, Sivagiri Taluk	CTE	KILN
62	Sri Virupa Enterprises 300/1A, Paruvakudi, Sankarankovil Taluk	CTO	KILN
63	M.S.P.V. Chemicals 348-1, Main Road, Pavoorchatram-627 808, Tenkasi Taluk	CTO	KILN
64	Ramalakshmi Limes 111-2A,2B,4A,4B,7A,7B, Munneerpallam, Palayamkottai Taluk Tirunelveli District.	CTE	KILN
65	Transworld Mining Industries P Ltd 22 1, Singikulam, Nanguneri Taluk, Tirunelveli District	CTO	KILN

Annex 4 Lab Analysis of Local Lime Stone Grades[15]

Tests	Protocol	Result		
		Calcite Grade	Dolomite Grade-1	Dolomite Grade-2
Calcium as $CaCO_3$	ASTM C-25-1999			
Calcium as $CaCO_3$	By conversion	97.11%	64.32%	58.00%
Carbonate as CO2	By Schotter Apparatus	44.22%	40.53%	42.10%
Chloride as Cl	ASTM C 25 99	0.032%	0.040%	0.040%
Insoluble Residue as IR	ASTM C 25 99	0.50%	4.27%	4.11%
Magnesium as $MgCO_3$	ASTM C 25 99 by conversion	0.63%	30.37%	36.97%
Loss on Ignition (LOI)	ASTM C 25 1999	44.44%	40.71%	42.27%
Silica as SiO_2	ASTM C 25 1999	0.22%	3.80%	3.71%
Iron as Fe_2O_3	ASTM C 25 1999/ICP OES	0.06%	0.39%	0.14%
Aluminum as Al_2O_3	ASTM C 25 1999/ICP OES	0.031%	0.10%	0.050%
Calcium as CaO	ASTM C 25 1999	54.42%	36.04%	32.50%
Magnesium as MgO	ASTM C 25 1999	0.30%	14.52%	17.68%
Sodium as Na_2O	ASTM C 25 1999	0.09%	0.080%	0.24%
Potassium as K_2O	ASTM C 25 1999	0.03%	0.032%	0.031%
Sulphur as SO_3	ASTM C 25 1999	0.035%	0.039%	0.030%

[15] SGS Laboratories Report No CH: GL : 3110036373/4/5, dated 30-Aug-12