SAMEEEKSHA

SMALL AND MEDIUM ENTERPRISES: ENERGY EFFICIENCY KNOWLEDGE SHARING

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NEWSLETTER

A PLATFORM FOR PROMOTING ENERGY EFFICIENCY IN SMEs

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Editorial

Micro, Small and Medium enterprises often operate in highly competitive markets. As such, to change business practices or technologies can be more a challenge than an opportunity for MSMEs due to the cost of investment and lack of know-how. Yet in view of global environmental degradation and resource depletion, the transformation towards more resource and energy efficient business practices will soon become a key factor of survival and success. In addition, the local environmental regulations, high costs of energy and uncertainties in the supply of electricity also nudge MSMEs to change and adapt.

Over many years, the different partners of the SAMEEEKSHA platform such as SDC have assisted MSMEs by promoting best practices to reduce energy consumption, financing energy efficient equipments for expansion plans and upgrading from old to new energy efficient technologies. The SAMEEEKSHA partners have thus contributed to maintaining healthy MSMEs whose individual entrepreneurship and innovations are vital for India's future economic development.

My visits to foundries and interactions with industry stakeholders in Coimbatore and Chennai, as well as interactions with government partners over the last six months, have reinforced the conclusion that the time is ripe to move to the next level by coordinating better across different initiatives and developing a supportive policy framework. In its invitation letter to the launch of its Cleantech Initiative with UNIDO and GEF, the Ministry of MSME announced its wish to synergize initiatives of various organizations for promoting clean energy technology innovations. We at SDC welcome this initiative and hope that the SAMEEKSHA platform and its members will contribute to upscaling energy efficiency in select MSME clusters in a coordinated manner.

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MSME

CLUSTER PROFILE

ANKLESHWAR CHEMICAL CLUSTER

Background

India is the third-largest producer of chemicals in Asia, and the 12th largest in the world. The state of Gujarat alone contributes 54% of basic chemicals and 59% of petrochemicals produced in India. About 50% of the total chemical production in Gujarat comes from the industrial town of Ankleshwar, in Bharuch district of Gujarat, making it the most significant chemical cluster in Gujarat as well as India. The Ankleshwar industrial estate and the nearby Panoli industrial estate together host over 700 MSMEs manufacturing various kinds of chemicals. Most of these MSMEs (67%) manufacture dyes and pigments, about 27% pharma and pharma intermediates, and the remaining 6% pesticides and chlor-alkalis. The MSMEs differ greatly in terms of production capacity, from 100 tonnes to 1000 tonnes per annum (tpa).

The development of the Ankleshwar chemical cluster began in the 1970s, when the Gujarat Industrial Development Corporation (GIDC) set up the Ankleshwar Industrial Estate. Its growth has been boosted by a number of factors including the setting up of numerous textile manufacturing units in the city of Surat, about 70 km from Ankleshwar; the attractive margins in the chemical industry; incentives offered by GIDC like capital subsidies and tax holidays; and the establishment in the region of many large-scale chemical and pharmaceutical plants which procure a range of basic chemicals from the MSMEs. Ankleshwar has the infrastructure for the supply of natural gas (NG) as fuel, and is well connected by rail and road to the major cities and ports.

There are two major industry associations in the cluster: the Ankleshwar Industries Association (AIA) with a membership of over 1200 units, and the Panoli Industries Association (PIA) with a membership of about 225 units. The main activities of AIA and PIA include infrastructure development through members' participation; environmental preservation and pollution control; providing guidelines for meeting legal requirements and green belt development; and disaster prevention and management. The cluster has a number of public and private labs that offer testing and R&D facilities, engineering colleges and technical training institutes that supply the technical workforce for the industrial units. Other important cluster-level actors include:

- GIDC—provides land and infrastructure to units and manages the day-to-day operations of the common effluent treatment plants that have been set up jointly with AIA in Ankleshwar and PIA in Panoli.
- Gujarat Gas Company Ltd (GGCL)—a gas transmission and distribution company that supplies piped natural gas to industries in the Ankleshwar cluster.
- Gujarat Pollution Control Board (GPCB)—ensures adherence to pollution and effluent discharge norms.

Profile of MSME units in Ankleshwar chemical cluster

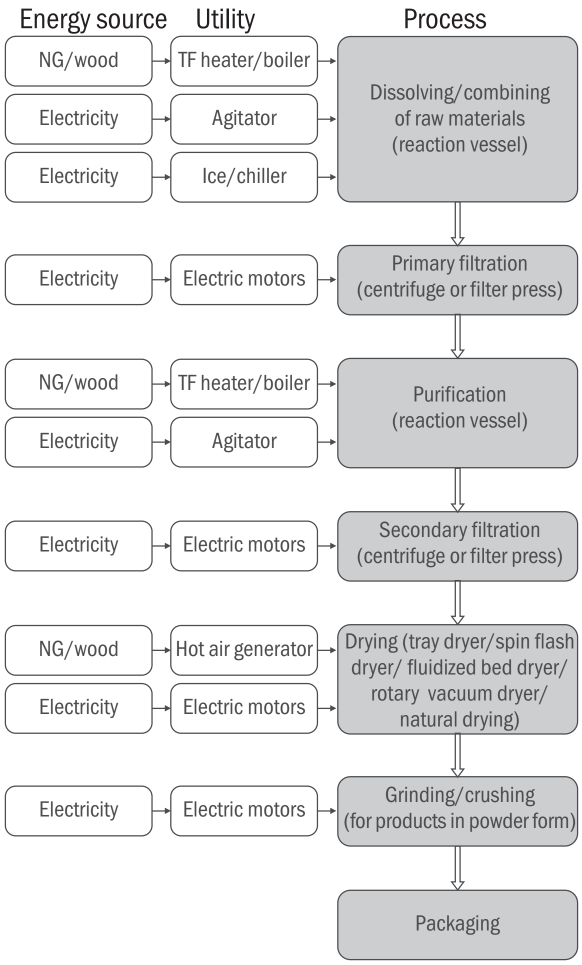
Category	*No. of units*	*% of total*
Dyes and pigments	485	67
Pharma & pharma intermediates	195	27
Pesticides	36	5
Chlor-alkali	7	1
Total	723	100

View of chemical unit

- Dakshin Gujarat Vij Company Ltd (DGVCL)—supplies electricity.
- Financial institutions—there are around 25 banks operating in the cluster. They provide the units with financial assistance for upgradation. Bank of Baroda is the lead bank for the district. SIDBI services the Ankleshwar cluster through its Vadodara branch.

Technology status and energy use

The MSMEs in the Ankleshwar cluster use a variety of basic chemicals as raw materials to manufacture the end-products. These basic chemicals are classified according to their chemical composition (organic and inorganic), origin (mineral, vegetative and animal) and physical state (solid, liquid or gas). The majority of these raw materials are sourced locally. There are about 40–50 micro and small chemical units that process basic chemicals to produce other chemicals which, in turn, serve as raw materials for other small and medium-sized units. Although the Ankleshwar units manufacture a variety of chemical products, the basic processes and the equipment used by different units are quite similar, as summarized below.



Process flow chart

Process equipment used in typical chemical unit

Equipment	*Energy source*	*Function*	*Types/Capacity range*
Steam boiler	Natural gas/wood	Steam generation	300 –3000 kg steam/hour
Thermic fluid heater	Natural gas/wood	Indirect (dryer and jacket) heating	1–4 lakh kcal/hour
Reaction vessel	Electricity (for agitator)	Dissolving/combining materials	1000 –10000 litres
Hot air generators	Natural gas/wood	Generating hot air for dryers	1–2 lakh kcal/hour
Centrifuges	Electricity	Separation of intermediate product (liquid or suspended solid) from slurry	24–48 inches basket size
Press filter	Electricity	Separation of solids from liquids using hydraulic press and compressed air	–
Air compressors	Electricity	Providing compressed air for press filter and other applications	5–7 kg/cm^2
Dryers	Heat (from hot air generators)	Removing liquids from products through evaporation	Tray, spin flash, etc.
Circulation pumps	Electricity	Circulation of boiler feed water, oil in TF heaters, cooling/ process water	Wide range
Chilling system	Electricity	Cooling of reactants/products	5–50 tons of refrigeration (TR)
Electric motors	Electricity	For equipment like agitators, pumps, fans, centrifuges, dryers, etc.	Wide range

Thermic fluid heater

Wood-fired boiler

In general, units use locally fabricated reaction vessels for low–medium temperature operation. Agitator systems used for stirring the chemicals in reaction vessels are of the inefficient horizontal type, resulting in wastage of energy. Most of the boilers, thermic fluid heaters and hot air generators used by the units are low in efficiency as they do not have pre-installed mechanisms for waste heat recovery. Chilling systems and dryers too are usually low in efficiency. Standard-make, low efficiency electric motors are used in equipment like agitators, centrifuges and circulation pumps.

Energy use

Energy accounts for a sizeable portion of manufacturing costs for the chemical units. The energy costs are 5–7% of manufacturing costs for inorganic chemicals, and about 12–15% for dyes and other organic chemicals. The main sources of energy are piped natural gas, electricity, and firewood. Natural gas and firewood are used to supply thermal energy for heating utilities such as steam boilers, thermic fluid heaters, and hot air generators. Electricity is primarily used in electric motors to run utilities such as agitator systems, air compressors, centrifuges, circulation pumps, and chilling plants. The total annual energy consumption of the chemical units in the Ankleshwar cluster was estimated at about 408,000 tonnes of oil equivalent (toe) for the year 2010–11.

Annual energy consumption in Ankleshwar chemical cluster

Energy source	*Annual consumption*	*Tonnes of oil equivalent (toe)*
Natural gas	381.9 million SCM	324677
Electricity	715 million kWh	82706
Firewood	3250 tonnes	1040
Total		408423

Options for energy saving

TERI has conducted a large number of walk-through and detailed energy auidits in the Ankleshwar chemical cluster. These studies have suggested that there is significant scope for improving the energy efficiency of various equipment being used by the chemical units in Ankleshwar. The main energy conservation measures having potential for replication are summarized in the following table:

Key energy conservation options in Ankleshwar cluster		
S. No.	*Energy conservation options*	*Energy saving potential*
Thermal system & utility		
1	Fuel switchover in steam generator and thermic fluid heater	High
2	Replacement of inefficient boiler with energy efficient boiler	Medium
3	Optimization of combustion to reduce flue gas losses	Medium
4	Installation of energy efficient burner	Medium
5	Reduction in surface heat losses through appropriate insulation	Low
6	Condensate recovery	Low
7	Waste heat recovery from flue gases	Low
Electrical system & utility		
1	Installation of energy efficient pump	Medium
2	Replacement of inefficient air compressor with energy efficient compressor	Medium
3	Installation of VFD to cater to variable process load requirements	Medium
4	Replacement of low efficiency motor with IE2 category motor	Medium
5	Installation of auto star-delta starter	Low
6	Thermo static controller in process chiller and cooling tower fan	Low
7	Use of energy efficient lighting system	Low
Process level interventions		
1	Changeover from open pan evaporator to spray dryer	High
2	Changeover from single stage evaporator to multi-stage evaporation system	High
3	Redesigning of air circulation pattern in tray dryer to optimize heat utilization	Medium
4	Optimization of cooling water system used in the process	Medium
5	Replacement of horizontal agitator system with vertical agitator system	Medium
Other energy conservation measures/technologies		
1	Installation of solar water heater for pre-heating of process/boiler feedwater	Medium

Compiled by TERI based upon the ongoing activities being undertaken by TERI under the World Bank–GEF–SIDBI project titled 'Financing Energy Efficiency at MSMEs'

Implementing Low-Carbon Technologies: Gas Heat Pump Technology For Improving Energy Efficiency of Investment Casting Units

A CASE STUDY FROM RAJKOT CLUSTER

Backdrop

Rajkot, located in the state of Gujarat, is an important engineering cluster in the country. The cluster is renowned for its entrepreneurship and product specialization. There are an estimated 2200 engineering units in the cluster, the majority of which are in the small-scale sector. These engineering units manufacture a range of products such as castings, pump-sets, automobile components, diesel engine generating sets, bearings, machine tools and so on. Rajkot is a prominent foundry cluster in India, with over 500 foundry units. Rajkot hosts the highest concentration of investment (precision) castings units in India—about 70 out of a total of 120 units in the country. Most of these units are members of Rajkot Engineering Association (REA). Many of the investment casting units sell their products to multinational firms, and some are also exporting to countries in Europe, the Middle East and the Southeast Asia. The investment casting units use electricity, natural gas (NG) and other fuels in their processes.

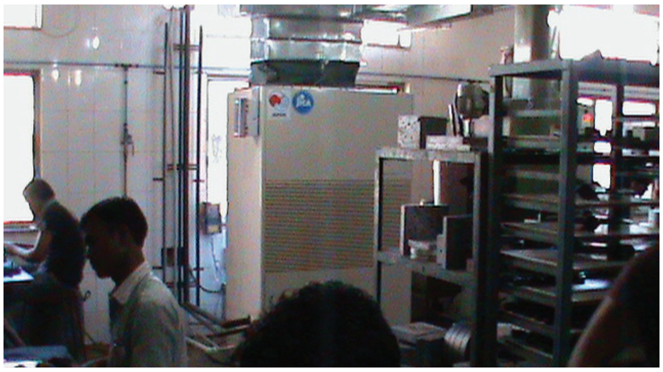
Investment casting—technology

Investment casting is one of the oldest known techniques of metal-forming. The term 'investment' comes from the traditional solid mould process, in which a plaster-like material (stucco) is poured or 'invested' into a container holding an assembly of wax patterns that are identical to the final metal products desired. After the plaster has set, the disposable wax patterns are melted and/or burned off, leaving hollow cavities into which molten metal is poured to yield the desired products. Beeswax was used 5000 years ago to make the wax patterns; today, the patterns are made using high technology waxes, refractory materials and specialist alloys. In the typical 'lost wax' process used today, wax is injected into an aluminium die to produce a wax pattern that is an exact replica of the desired component. A number of such wax patterns are assembled around a sprue (i.e. a central wax rod which acts as a channel through which molten material is introduced into a mould), repeatedly dipped into a vat of agitated ceramic material, and allowed to dry. The ceramic coated moulds are then de-waxed by heating in a wax bath or autoclaving. The hollow ceramic shells that remain are pre-heated, and molten metal is poured into them to produce the required castings. The shells are cooled; the ceramic material is removed from the metal castings by water blasting or vibrations; and the castings are separated from the sprue and cleaned.

The investment casting process allows the production of castings with utmost accuracy, repeatability and versatility in a variety of metals and high-performance alloys, making it the most preferred method to produce dimensionally accurate high-precision casting components for major industry sectors such as automobiles; general engineering; valves, compressors and pumps; pharmaceuticals; textile and sewing machinery; defence equipments; food processing machinery; power and hand tools; and so on.

Intervention

With an objective to promote application of 'low carbon' Japanese technologies among SMEs in India, the Ministry of Environment and Forests, Government of India (MoEF) and the Government of Japan initiated a research project titled 'Research Partnership for Application of Low Carbon Technology for Sustainable Development'. The project is funded by Japan Science and Technology Agency (JST) and Japan International Cooperation Agency (JICA), with TERI and Institute for Global Environmental Strategies (IGES), Japan as the research partners. Under the project, feasibility studies were conducted before undertaking demonstration of



GHP system – outdoor unit (L) indoor unit (R)

cleaner technologies from Japan among Indian SMEs. Gas heat pump (GHP) has been successfully demonstrated in selected investment casting SMEs in Rajkot and demonstration of electric heat pump (EHP) technology is planned in a chocolate factory in Gujarat and a dairy unit in Chandigarh. The project also aims to implement best operating practices for air compressor and induction furnace systems in various SME sub-sectors. A Joint Coordination Committee has been set up to guide the research activities under the chairmanship of MoEF.

A small-scale investment casting unit in Rajkot named Delta Technocast Pvt. Ltd was selected for demonstration of an energy efficient GHP air conditioning system developed by Japanese manufacturers. The unit uses the lost-wax process to manufacture precision investment castings of ferrous and non-ferrous metals, alloys and super alloys.

In a gas heat pump (GHP) air conditioning system, a gas engine is used to drive the compressor. Only the fan and peripheral equipment consume electricity. Hence, the electricity consumed by a GHP system is much less than that consumed by an electrical system of similar capacity.

The project conducted detailed studies at the unit to gather baseline performance data and identify possible energy saving options. Based on the studies, the project recommended the installation of an energy efficient GHP air conditioning system to replace the existing electrical air conditioning system for drying castings. In the electrical drying system, electricity was drawn to run the compressor and the refrigerant used was R-22, an ozone depleting substance. The GHP air conditioning system uses a NG-based engine to drive the compressor, and the refrigerant used is R410A, which has zero ozone depleting potential. The GHP system was designed and customized by a Japanese manufacturer, YANMAR Energy System Co. Ltd, and commissioned at Delta Technocast in February 2013.

What is an air conditioning system?

When a liquid evaporates, it usually takes up heat from the surroundings. Conversely, when the vapour condenses, it releases heat back to the surroundings. Air conditioning systems utilize this characteristic for cooling or heating based on a process called 'refrigeration cycle'. A suitable fluid (called coolant or refrigerant) is circulated and repeatedly evaporated and condensed by means of a compressor to produce cooling and heating as required.

Results

The project has been monitoring the performance of the GHP system following its commissioning. The preliminary results establish the reliability and viability of the system. Installation of the GHP system required an investment of around 2.8 million rupees, compared to around one million rupees for the electrical system. However, the primary energy consumption of the pilot GHP system (179 million kcal/year) is just about half that of the electrical system (342 million kcal/year). This represents a 48% reduction in primary energy consumption. In terms of curtailing greenhouse gas emissions, this translates to a reduction of 54 tonnes of CO_2 emissions each year. Also, the shift to using the ozone-friendly R410A refrigerant represents a small but significant step towards preserving the ozone layer.

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Compiled by TERI based upon the ongoing activities being undertaken by TERI, IGES under the JICA- JST project

ABOUT SAMEEEKSHA

SAMEEEKSHA is a collaborative platform aimed at pooling the knowledge and synergizing the efforts of various organizations and institutions—Indian and international, public and private—that are working towards the common goal of facilitating the development of the small and medium enterprise (SME) sector in India, through the promotion and adoption of clean, energy-efficient technologies and practices.

SAMEEEKSHA provides a unique forum where industry may interface with funding agencies, research and development (R&D) institutions, technology development specialists, government bodies, training institutes, and academia to facilitate this process.

ABOUT TERI

A dynamic and flexible not-for-profit organization with a global vision and a local focus, TERI is deeply committed to every aspect of sustainable development. From providing environment friendly solutions to rural energy problems to tackling issues of global climate change across many continents and advancing solutions to growing urban transport and air pollution problems, TERI's activities range from formulating local and national level strategies to suggesting global solutions to critical energy and environmental issues.

With staff of over 900 employees drawn from diverse disciplines, the institute's work is supported by ministries and departments of the government, various bilateral and multilateral organizations, and corporations of repute.

VISION OF SAMEEEKSHA

SAMEEEKSHA envisages a robust and competitive SME sector built on strong foundations of knowledge and capabilities in the development, application and promotion of energy-efficient and environment-friendly technologies.

FOR MORE DETAILS, PLEASE CONTACT

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