SMALL AND MEDIUM ENTERPRISES: ENERGY EFFICIENCY KNOWLEDGE SHARING

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SAMEEEKSHA NEWSLETTER

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Inside...

Promoting Energy Efficiency in SMEs

SAMEEEKSHA

VISION

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.

ENERGY IS LIFE
B E E
CONSERVE IT
Bureau of Energy Efficiency

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Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC

teri
The Energy and Resources Institute

MSME
MICRO, SMALL & MEDIUM ENTERPRISES

A PLATFORM FOR PROMOTING ENERGY EFFICIENCY IN SMEs

IN THIS ISSUE...

One of the primary aims of the EESE project under the TERI–SDC partnership is to explore possibilities of improving energy efficiency in the secondary aluminium industry. This highly energy intensive sector mainly comprises MSMEs, which produce aluminium from recycled metal scrap and convert it to ingots or other finished products such as castings, extrusions etc. for use by other industries such as automotive, consumer durables, construction, utensils, electrical, packaging and transportation.

This issue carries stories that provide a picture of the secondary aluminium industry including its energy usage and the potential for improving energy efficiency: a profile of the Pune aluminium castings cluster; a summary of the detailed energy audits conducted by TERI in a few units in the Chennai aluminium casting cluster; and the gist of a consultation meeting held by TERI–SDC with sectoral stakeholders in Chennai.

The secondary aluminium industry is growing rapidly with sectors like automobiles/automotive components, construction, electrical being major consumers. The expanding market opportunities make it all the more imperative for units to improve their competitiveness—by acquiring new/improved technologies, adoption of best operating practices, and enhancing the skill-sets of plant personnel via technical training and capacity building programs. Units could take advantage of the ongoing government initiatives like ‘Make in India’, ‘Zero Defect Zero Effect’, and ‘Skill India’, which are structured to meet precisely these needs of Indian industry. It is worth noting that ‘Make in India’ lists, among its focus sectors, the automobile, auto components, aviation and electrical industries—sectors that are among the most important clientele for the secondary aluminium industry.

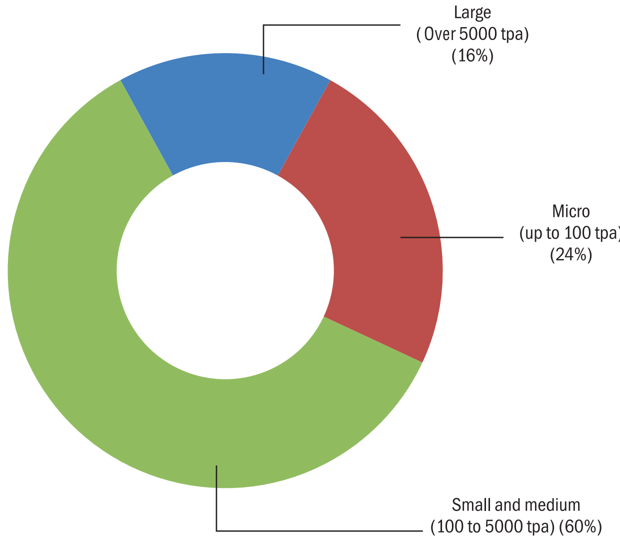
SAMEEEKSHA Secretariat

PUNE ALUMINIUM CASTING CLUSTER

Background

The metropolitan city of Pune, in Maharashtra, is also an industrial hub with 25 industrial estates hosting over 3000 energy intensive units, representing a range of industrial sub-sectors such as automotive, chemicals, engineering components, forging, IT, metal casting, pharmaceuticals, and sugar. Most of these units are MSMEs. Among the large-scale industries established in Pune are Bajaj Auto, Bharat Forge, Force Motors, Jaya Hind Industries, Mahindra, Mercedes Benz, Tata Motors, and Volkswagen.

Pune hosts a cluster of about 50 aluminium casting units, comprising 12 micro units, 30 SMEs, and 8 large-scale units. The cluster produces about 400,000 tonnes per annum (tpa) of aluminium castings, amounting to about 22% of India's total aluminium castings production. A majority of the units cater to the automotive sector. Castings are also produced for sectors such as electrical & electronics, consumer durables, etc. The casting products include aluminium alloy wheels, cylinder heads, engine bodies, engine pipes, suspension forks, electrical motors, pumps, fans, etc. The client industries include automobile giants like Bajaj Auto, Honda, M&M and Tata, and electrical majors like Siemens and Crompton Greaves. The growth of the aluminium casting industry is being spurred by India's emergence as a hub for the manufacture of automobiles, and by the global drive towards improving fuel efficiency and reducing the curb weight of vehicles.



Profile of aluminium casting units in Pune

The prominent industry associations and other stakeholders associated with the aluminium casting units in Pune are listed below.

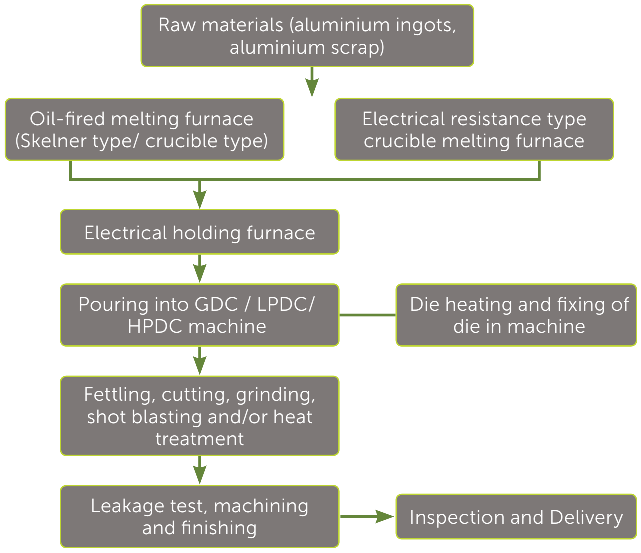
Name of association	Profile
Aluminium Casters' Association of India (ALUCAST)	ALUCAST has about 100 members in Pune comprising foundry units, foundry consultants, equipment suppliers, and local service providers (LSPs). ALUCAST organizes an annual conference and exhibition for the benefit of aluminium casting industries in India. See http://www.alucast.co.in/.
Maharashtra Chamber of Commerce, Industry & Agriculture (MACCIA)	MACCIA has about 3000 members comprising foundries, automotive, sugar, textile, engineering, and other industries. See http://www.maccia.org.in/.
National Centre for Technical Services (NCTS), Pune	NCTS, Pune, is one of the four Centres of Excellences established by the Institute of Indian Foundrymen (IIF). NCTS provides technical services and expertise to improve the global competitiveness of metal casting units (foundries). See http://www.iifncts.org/.
Arkey Technical Training and Research Institute, Pune	Arkey Technical Training & Research Institute organizes conferences and training programs for the foundry, forging, welding and construction industries. It also conducts a training course on aluminium die casting technology with the Vishwakarma Institute of Technology, Pune. See http://www.arkeycell.com/.
Deccan Chamber of Commerce Industries & Agriculture, Pune (DCCIA)	The DCCIA seeks to generate systematic collaboration between all those involved in the process of innovation. See http://www.dcciapune.org/.

Technology status and energy use

The flowchart shows the major process steps in a typical aluminium casting unit. Most of the units use aluminium alloy ingots as raw material; a few units use scrap aluminium. The raw material is charged in a melting furnace, which may be either direct heating (Skelner) or indirect heating (crucible) type. When molten metal temperature of about 750–800°C is achieved, the liquid aluminium is transferred to electrical holding furnaces, from where it is sent for die casting. About 70% of all the melting furnaces used in the cluster are oil/gas-fired; the remaining 30% are electrical resistance furnaces. A few progressive units have started using tower type melting furnaces, which provide the advantage of continuous melting with low fuel consumption and reduced material losses (around 2%) compared to the Skelner furnace (4%).

Crucible furnace

Three types of die casting processes are used: (1) gravity die casting (GDC), (2) low pressure die casting (LPDC), and (3) high pressure die casting (HPDC). The prepared castings are sent for finishing operations, which include cutting of runners and risers, fettling, grinding (using pneumatic or electric grinders), and de-coring of sand castings. Some castings are subjected to shot blasting to impart surface finishing, and heat treatment to relieve stress.



Process flow chart in aluminium casting unit

Energy consumption

Energy is used in two forms for melting metal: thermal and electrical. The fuels used are furnace oil (FO), piped natural gas (PNG) and liquefied petroleum gas (LPG). Other processes such as holding of molten metal, die casting, core heating, machining, shot blasting, etc., are all carried out using electricity, irrespective of the type of melting furnace in use.

The total energy consumption of the Pune aluminium casting cluster is estimated at 77,800 tonnes of oil equivalent (toe), of which thermal energy accounts for 47,400 toe (61%) and electricity accounts for the remaining 30,400 toe (39%). The specific energy consumption (SEC) varies considerably among the units, depending on the type of melting furnace used, the finishing operations carried out on the castings, and the degree of mechanization. Table 1 summarizes the typical energy consumption and SEC data for four kinds of aluminium units in the Pune cluster. Table 2 shows the cluster-level energy consumption.

Skelner furnace

Table 1. Typical energy consumption patterns in Pune aluminium casting units (2014)							
Melting furnace type	Annual energy consumption (fuel-units)			Total energy consumption (toe/year)	Annual Production (t)	SEC (toe/t)	CO_2 emission (t CO_2/t)
	FO (L)	PNG (SCM)	Electricity(kWh)				
Oil/gas crucible[1]	180,000	150,000	492,000	347.5	1500	0.23	0.843
Oil/gas Skelner[1]	212,868	–	2,779,310	439.0	2391	0.18	1.396
Electrical crucible[1]	–	–	695,466	59.8	807	0.07	0.845
Oil/gas Tower[2]	275,000	–	3,850,000	601.0	6500	0.09	0.702

[1] Actual figures from operating units based on TERI projects
[2] Estimate based on figures from equipment vendor

Table 2. Energy consumption in the Pune aluminium casting cluster (2014)			
Energy source	Annual consumption	Equivalent (toe)	Annual energy bill (million rupees)
Electricity	350 million kWh	30,063	2,971
FO	44,153 kL	43,579	1,590
NG	1.206 million SCM	1,025	54
LPG	210 tonnes	263	18
HSD	2592 kL	2536	143
	Total	77,466	4,776

Options for energy saving

Table below summarizes the major energy-saving opportunities for the cluster units.

Energy conservation measures for aluminium casting units in the Pune cluster
ECM
Improved operating practices
Use of lid mechanism in electrical melting and holding furnaces
Use of thyristor for electrical heating for better temperature control
Use of better refractory and insulation for furnaces
Insulation of core shooters and heater optimization
Compressed air system optimization
Retrofit
Installation of 'variable frequency drives' (VFD) and automation
Use of EE burners with automation in oil/gas fired furnaces
Installation of waste heat recovery systems (recuperators) for Skelner furnaces
Voltage regulators for transformers and on load tap changer (OLTC)
Replacement of metal blades with 'fibre reinforced blades' (FRP) in cooling towers
New plant/equipment
Replacement of crucible type oil-fired furnaces with EE tower furnaces/ electrical furnaces
Replacement of conventional Skelner furnace with EE tower furnace
Replacement of rewound motors with EE motors
Replacement of inefficient air compressor with EE compressor (reciprocating with screw type)
Switching over to EE lighting and controls

Compiled by TERI from 'Cluster Profile – Pune Aluminium Casting Cluster', 2015, prepared under the TERI–SDC 'EESE' program

IDENTIFYING EE OPPORTUNITIES IN THE CHENNAI ALUMINIUM CASTING CLUSTER

About the cluster

The city of Chennai hosts a cluster of MSMEs engaged in aluminium die casting. There are about 200 units in the cluster, including 120 pressure die casting (PDC) and 80 gravity die casting (GDC) units. The units are concentrated mainly in two areas: Thirumudivakkam and Ambattur. The total production of the cluster is about 75,000 tonnes per annum (tpa).

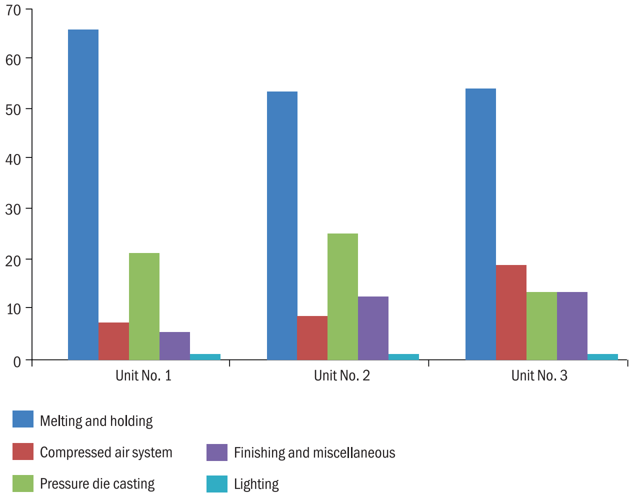
About the intervention in units

Under the TERI-SDC partnership project, detailed energy audits were conducted during 2015 on three progressive aluminium casting units in the Chennai cluster. All three units manufacture castings for the automotive and other engineering sectors, using the pressure die casting (PDC) process. The main raw materials used are aluminium billets/alloy ingots. These are melted in an electrical or diesel-fired furnace, and the molten metal is transferred to an electrical holding furnace. For making castings, the liquid metal is drawn from the holding furnace and forced under high pressure into a steel tool; the alloy hardens rapidly and takes the form and finish of the tool. Table 1 profiles the three units. The chart provides the percentage-wise break-up of energy consumption for all three units.

The energy audits helped identify a number of factors that resulted in energy losses. Among them, the following factors were common to all three units:

- The melting/holding furnaces did not have lid mechanisms. As a result the molten metal was exposed to the atmosphere, resulting in significant heat losses.

Diesel fired bulk melting furnace



Break-up of energy consumption (%)

Table 1. Profiles of the three aluminium casting units in Chennai cluster

No.	Name	Capacity (tpa)	Annual energy consumption (toe)	Existing melting furnaces and allied systems
1	Unit No. 1	600	Electricity– 33 Diesel – only for backup	• Five electrical melting-cum-holding furnaces, each catering to one PDC system.
2	Unit No. 2	1200	Electricity –125 Diesel – only for backup	• Six electrical melting-cum-holding furnaces, each catering to one PDC system.
3	Unit No. 3	2400	Electricity–221 Diesel–192	• One diesel-fired bulk melting furnace • Nine electrical holding furnaces, each catering to one PDC system.


Unit no. 2


Unit no. 3

- Leakages were detected in the compressed air systems. Also, the air pressure settings were not optimized to match the actual requirements of compressed air.

Energy conservation measures

Based on the energy audits, the project identified and recommended a number of energy conservation measures (ECMs) for implementation by each unit. Table 2 lists some of the recommended ECMs.

Table 2. Select ECMs recommended for implementation

Unit	ECM
Unit No. 1	Reduce radiation loss in electric melting furnace
	Arrest compressed air leakages ,reduce pressure setting
	Replacing hydraulic pump with servo pump in 180 PDC machine
Unit No. 2	Reduce radiation loss in electric melting furnace by installing lid mechanism
	Install online energy monitoring system; improve power factor
	Retrofit air compressor with VFD; reduce air leakages in system
	Replace inefficient melting furnace with EE electric furnace
Unit No. 3	Retrofit bulk melting furnace to utilize waste heat
	Replacement of electric crucible holding furnace by top-heated electric furnace
	Arrest compressed air leakages, repair the air manager system

Compiled by TERI from the energy audit reports prepared on the three units mentioned above under the TERI-SDC partnership project (2015)

REGIONAL CONSULTATION ON EE IMPROVEMENTS IN SECONDARY ALUMINIUM SECTOR

One of the focus areas of the TERI-SDC partnership project is to help develop a comprehensive program for adoption of clean, energy efficient technologies in the secondary aluminium industry. This is among the most energy intensive industrial sub-sectors in the country, and mainly comprises MSMEs. TERI developed a concept note for energy efficiency improvements in the secondary aluminium sector. With a view to discuss the concept note with stakeholders and obtain their feedback and suggestions, TERI organized a Regional Consultation in Chennai on 26th February 2016, in association with IIF- Chennai Chapter. The event was attended by over 40 delegates, including representatives from the aluminium casting industry, IIF, technical consultancy organizations, and MSME-DI.

In his welcome address, Mr A Pari, Director, CRP (India), Chennai underlined the importance of energy conservation in the highly energy intensive aluminium industry. He expressed hope that under the proposed program, TERI–SDC would be able to develop an aluminium melting furnace that would offer high energy efficiency and low melting loss, and would at the same time be affordable to a small enterprise. Mr Prosanto Pal, TERI, provided a background of the secondary aluminium industry in India, with a summary of the different technologies in use, the energy consumption, and the significant scope for energy saving through the adoption of energy efficient melting technologies and better

operating practices. Mr. Daniel Ziegerer, SDC, spoke on the technology development and dissemination model that the TERI–SDC partnership has evolved and successfully implemented in various MSME sectors for 20 years, thereby helping entrepreneurs save costs and strengthen the economic sustainability of their units. The project experience has underlined the need for entrepreneurs to be open to change; to listen to new ideas and take a calculated risk to improve the industry: such traits are "part of the natural cycle of being an entrepreneur".

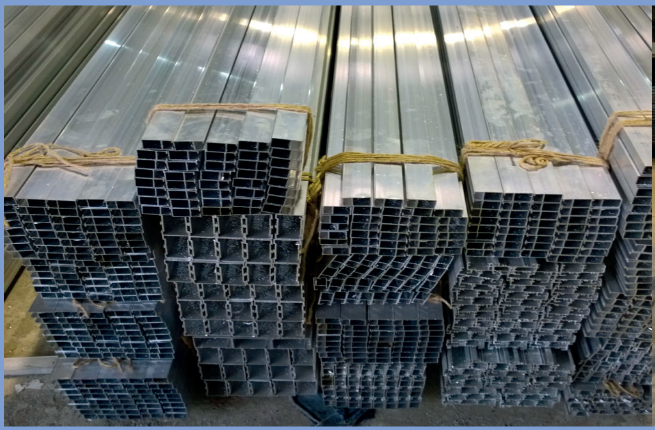
A panel discussion followed on 'Key elements of formulating a national level program for improving the energy efficiency of the secondary aluminium sector'. It was chaired by Mr S H Arjunwadkar, Chairman, National Centre for Technical Services (NCTS), Pune. The other panelists were Dr. Anand Shukla, Senior Thematic Advisor, SDC, Delhi; Mr Anand Joshi, Consultant, Pune; Mr Arup Krishna Saha, Minex Metallurgical Company Ltd, Nagpur; Mr Yugal Bhasin, J B Metal Industries, Delhi; and Mr A M Praveen, Nutech Engineers, Chennai. The discussions helped elicit insights and ideas from the participants as to the kinds of efficient technologies and practices, capacity building initiatives, institutional development measures and policy frameworks that are needed for promoting energy efficiency in the secondary aluminium sector in India.

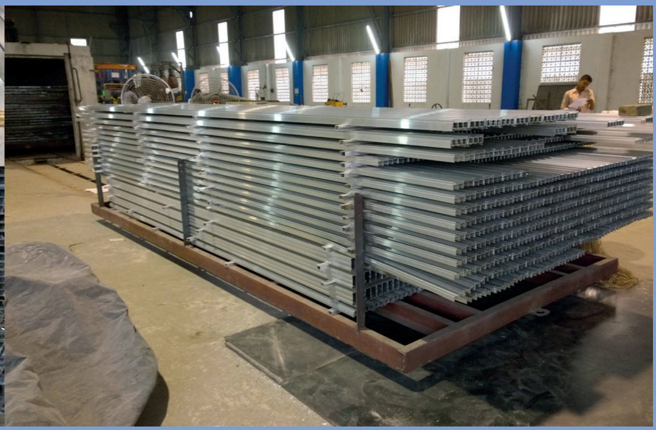
NEW AVENUES

EXTRUSIONS: AN EMERGING SUB-SECTOR OF THE SECONDARY ALUMINIUM INDUSTRY

Aluminium extrusion is picking up at a rapid pace in India, thanks to the burgeoning building, construction and consumer durables industries that are emerging as its major consumers. The annual production of the aluminium extrusions industry, comprising about 100 units is over 400,000 tonnes. However, the industry is highly fragmented with 70% of the units in small scale. Most of the units are concentrated in states like Gujarat, Delhi NCR, Telangana, Tamil Nadu and West Bengal. Since aluminium offers excellent mechanical properties, durability, corrosion and weather resistance, and undeniable aesthetic appeal, it is being widely used in the construction industry for a variety of applications. It helps in meeting aesthetic requirements and technical challenges for applications such as facades and interiors, roof construction, cladding, doors and windows, ceiling systems, high-quality light fittings and so on. The major products for the construction/building/consumer durables industry include door/window panes, bars, sheets, tubes, fencings, shutters, flooring steps/planks, AC grills, etc. Other applications where aluminium extrusions are being widely used include automotive components, solar panel frames & supports, bus bars and so on. Automotive sector has huge potential for extrusion products. As opposed to the average aluminium extrusions usage of 11.5 kg in Europe in passenger cars, the usage in India is as low as 2–3 kg per car.

In extrusion, the material is shaped by forcing it to flow through a shaped opening in a die. The extrusion process uses cast cylindrical billets as its raw material. The billets are sawn to typical lengths of 50–80 cm and heated to about 450°C. A hydraulic ram then forces the hot aluminium to flow through the die. Finally the extrusions are cut to length before being annealed. Temperature maintenance is most critical in the production process so as to achieve the essential characteristics of aluminium such as hardness and finish. The product is then heat treated and anodized as per requirement. At times, the ingots are preheated to 500°C to improve their metallurgical properties. Oil, gas or electricity are the major fuels used for heating of billets. The major energy consumption in an extrusion plant is electricity, which is used in heating, cutting, treatment and pulling. There appears to be a good potential to enhance the energy performance of the extrusion units by improvements in the melting process. TERI plans to include extrusion units as a key sub-sector in the proposed program for the secondary aluminium sector.





Extruded products

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.

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