CLUSTER PROFILE

PUNE FORGING CLUSTER

Background

The forging industry is one of the important contributors to the Indian economy, with a turnover of around Rs 15,000 crores (USD 3 billion) in 2007–08. Large, medium and small-scale forging units process a range of metals to manufacture forged components that are used in many industrial sectors, in particular, the automotive industry. A large portion of the forged products are exported to the US, Europe and China. In 2010–11, the Indian forging industry manufactured around 2.3 million tonnes of products for domestic and overseas markets.

What is forging?

Forging is one of the oldest known metal-working processes. In simplest terms, it is the process by which metal is shaped using localized compressive forces. Traditionally, forging was performed by a blacksmith in a workshop called 'smithy' or 'forge'. The metal part to be shaped is placed on an anvil and hammered into the desired shape. This manual method is practiced even today. However, industrial forging is done either with presses or with hammers powered by hydraulics, compressed air, electricity, or steam. Forging is often classified according to the temperature at which it is performed: thus, forging can be 'cold', 'warm', or hot'. Forged parts can range in weight from less than a kilogram to over 500 tonnes. The forging process produces a metal part that is stronger than an equivalent cast or machined part.

One of India's largest forging industry clusters is located in Pune, Maharashtra. All sectors of the automotive industry are represented in Pune: two-wheelers, auto rickshaws, cars, tractors, tempos, excavators and trucks. Among the large automotive companies located in and around Pune are Fiat, Force Motors (Firodia Group), General Motors, Kinetic Motors, Mahindra & Mahindra, Mercedes Benz, Tata Motors, and Volkswagen. Several automotive component manufacturers are located in the Pune area, including Continental Corporation, Friedrichshafen AG, Robert Bosch GmbH, Saint-Gobain Sekurit, Tata Autocomp Systems Limited, and Visteon. These automotive industries require forged products like axles, cams, connecting rods, crown wheels, gears, shafts, wheel hubs and so on, which are manufactured by the forging units in the cluster. Forged components are also manufactured for a range of other industries in and around Pune, from engineering firms and chemical manufacturers to sugar industries, ordinance factories and food processing plants.

The Pune forging cluster accounts for about 20–25% of the total national production of forged components. Large-scale forging units account for about 65–70% of the total forging production in the cluster, while MSMEs account for the remaining 30–35%. There are around 50 forging MSMEs located in Pune. In addition, there are around 20 heat treatment MSMEs that function as vendors to these forging units. These MSMEs provide direct and indirect employment to around 20,000 people, and are located in industrial estates developed by the Maharashtra Industrial Development Corporation (MIDC) in Pimpri–Chinchwad, Chakan, and Bhosari, as well as in other areas like Kharadi, Alandi, Haveli, Shikrapur and Sanaswadi.

The gross annual turnover of the forging MSMEs in Pune is estimated at Rs 500–600 crores (about USD 300 million), while that of the heat treatment MSMEs is Rs 80–100 crores (about USD 60 million). The production levels of the units range between 500–3500 tonnes per annum (tpa). The production levels have shown a downward trend in recent times, due to the slowdown

Closed-die forged components

Profile of forging and heat treatment MSMEs in Pune

Category	*No. of units*	*Size of units*			*Production level of units (tpa)*			*Total annual production (t)*	
		Micro	*Small*	*Medium*	*500–1000*	*1000–2000*	*2000–3500*	*2010–11*	*2011–12*
Forging	50	5	35	10	10	25	15	120,000	80,000
Heat treatment	20	–	13	7	5	15	–	40,000	28,000
Total	70	5	48	17	15	40	15	160,000	108,000

in the Indian automobile market as well as the slump in exports resulting from the downturn in the US and European economies.

The Association of Indian Forging Industry (AIFI) is the main industry association representing small-scale and large forging units in Pune, with about 150 members. AIFI plays an active role in promoting the forging industry, and pursues issues such as budget and export–import policies with the Government of India (GOI). AIFI also has strong linkages with its counterpart forging associations in the US, European countries, Japan and China. These linkages facilitate new business opportunities for member-units. With support from GOI, AIFI has established an R&D Centre at Chakan, which offers product testing and validation facilities for the forging industry in Pune. Other industry associations connected to the Pune forging cluster include Pimpri-Chinchwad Chamber of Industries, Commerce, Services and Agriculture; Maharashtra Chamber of Commerce, Industries and Agriculture; Chakan Industries Association; Pimpri-Chinchwad Small Industries Association; and Deccan Chamber of Commerce, Industries and Agriculture. Other important cluster-level stakeholders include:

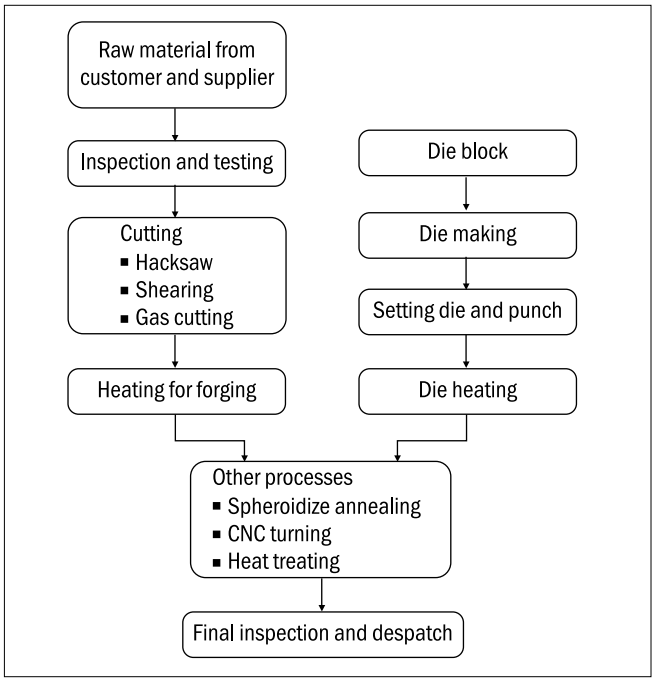
- The Automotive Research Association of India (ARAI)—it has a forging division which organizes training and undertakes R&D projects. ARAI has a testing and validation facility.
- MIDC
- District Industries Centre (DIC), Pune.
- Financial institutions—there are about 20 banks operating in the cluster. They provide the units with financial assistance for expansion and upgrade of infrastructure. SIDBI is the leading financial institution in the cluster, with several branches in Pune city and MIDC areas.

Technology status and energy use

In general, the forging process involves the following broad steps: (1) cutting and heating of billets; (2) forming operations; and (3) final treatments, such as flash removal, punching and cooling. Different kinds of forging processes are used by the units in Pune, such as closed or impression die forging; cold forging; open die forging; and seamless rolled ring forging. The major raw materials include mild steel, carbon steel, alloy steel, stainless steel, super alloy, non-ferrous metals, etc. Most of these raw materials are available locally or sourced from other domestic markets. The main equipment/systems used by the forging and heat treatment units include the following:

- *Oil and gas-fired furnaces*. Forging and heat treatment furnaces commonly use furnace oil (FO), light diesel oil (LDO) and LPG as fuel. The forging furnaces are used to heat the raw material (usually, billets of various grades of steel) to about 1200° C. The production capacities of the furnaces range from 50 kg/hour to 400 kg/hour. The furnaces have different designs like box, 'L' and pusher types. The heat treatment furnaces are used for normalizing, annealing, hardening, tempering and carburizing of forged and machined components according to job specifications. The oil consumption ranges between 100–200 litres/tonne in the forging furnaces, and 60–80 litres/tonne in the heat treatment furnaces. The gas consumption ranges between 100–150 standard cubic metre (scm)/tonne in the forging furnaces, and 50–80 scm/tonne in the heat treatment furnaces.
- *Electric furnaces*. Electrical energy is also used for heating billets for forging, and for heat treatment. The

Furnace oil fired forging furnace



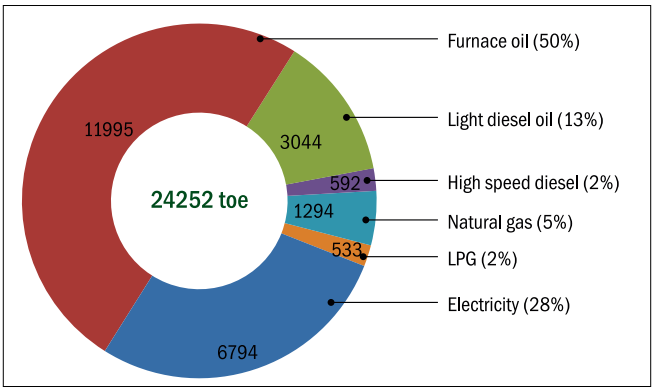
Process flowchart

production capacities of the electrical billet heating furnaces range from 45 kg/hour to 500 kg/hour, with connected loads ranging between 50 kW and 450 kW. The specific electricity consumption for the billet heating furnaces varies between 400–450 kWh/tonne. The electrical resistive heating furnaces used for heat treatment are either batch (pit) type or continuous (pusher) type, and have capacities ranging from 200 kg to 600 kg. The rating of the heat treatment furnaces varies from 45 kW to 120 kW.

- *Close die hammers of belt drop type*. These hammers are used to forge hot billets into various shapes for shafts, flanges, rollers, hubs and so on. The hammers have capacities between 0.5–3 tonnes. Electric motors of 30 hp to 100 hp are used to drive the hammers.
- *Pneumatic screw presses*. Screw presses with capacities ranging from 100 tonnes to 1500 tonnes are driven by electric motors of 30 hp to 150 hp. Screw presses with electric motors of 5 hp to 30 hp are used for trimming and coining operations.
- *Open die hammers*. These hammers, with capacities of 0.5 tonnes to 5 tonnes, are mainly used to forge certain kinds of shafts and flats.

Energy use

Electricity and other fuels are used by the forging furnaces as well as for heat treatment processes like hardening, tempering and stress relieving. Some of the forging and heat treatment units have both oil-fired furnaces and electrical furnaces for heating. The total annual energy consumption of the Pune forging and heat treatment units is estimated at 24,252 tonnes of oil equivalent (toe) in 2011–12.



Annual energy consumption

Options for energy saving

Around 80–90% of the energy consumed by the Pune forging cluster is used for heating. The balance energy is used by other equipment like hammers, presses, pumps, air compressors and so on. A large number of the forging and heat treatment units use inefficient systems that offer significant potential for energy saving. The options available for improving energy efficiency are summarized below.

Key energy saving options in Pune forging cluster

Energy saving option	*Energy saving potential*
Efficient induction furnace to replace old oil-fired forging furnace	30–70%
Efficient gas-fired furnace to replace old oil-fired heat treatment furnace	10–20%
Control systems for oil/gas-fired furnaces (burners, blowers, temperature controllers) for forging and heat treatment units	Up to 5–10%
Controls and best operating practices in compressed air systems for forging and heat treatment units	Up to 5–15%
Use of energy efficient motors and pumps	Up to 5–15%
Use of energy efficient lighting (like CFL, LED, T5 etc.)	Up to 5–10%

Compiled by TERI from 'Cluster Profile Report: Pune Forging Cluster', prepared by TERI in 2012 under the World Bank–GEF–SIDBI project titled 'Financing Energy Efficiency at MSMEs'