Cluster Profile
Rajkot pump set industries




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India

For more information

Project Monitoring Cell
T E R I
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi – 110 003
India

Tel. 2468 2100 or 2468 2111
E-mail pmc@teri.res.in
Fax 2468 2144 or 2468 2145
Web www.teriin.org
India +91 • Delhi (0)11

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Rajkot pump set industries

Overview of cluster

Rajkot, in the state of Gujarat, is one of the largest clusters of MSMEs (micro, small and medium enterprises) in the country. Earlier Rajkot was known for diesel engines all over the world. It was exporting diesel engines to African and Gulf countries. Diesel engine manufacturing was at its peak during the 1980s and early 1990s. However, the industry was severely affected after the farmers switched to electric pumps after expansion of the grid. The bearing industry also developed locally due to the demand for bearings in the diesel engine and pump set industry.

There are an estimated 14,000 MSME units in Rajkot cluster, of which around 5,500 are engineering units. The cluster is spread within Rajkot and neighboring Metoda and Shapar The engineering industry is diverse in nature. Some of the major engineering segments include foundry, investment casting, pump sets, forging, machine tools, auto components, building hardware, kitchenware, plastics and diesel engines generating sets, bearings, sheet metal, cables and wires, printing and packaging and food machinery.

Pumps are widely used in the agricultural, municipal, domestic and industrial sectors. Rajkot is one of the largest producers of submersible pumps for the agricultural and domestic sectors, as well as centrifugal pumps for domestic and industrial usage. The growth of pump industry in Rajkot is a relatively recent phenomenon: in 1994, there were only 10 pump manufacturing units in Rajkot. However, in the years that followed, the number of pump set units increased rapidly, matching the growth in demand for submersible pump sets in the agricultural sector due to depletion of groundwater levels all across the country and lack of surface water irrigation facilities. By 2010 there were about 350 pump manufacturers in Rajkot, and this number has grown to about 1000 in 2015! Due to the relatively lower manufacturing costs in Rajkot, some pump manufacturers even from other pump-set cluster such as Coimbatore are sourcing components from this cluster.

Product types and production capacities

There are about 1000 pump manufacturing units in Rajkot cluster. The pump industries in the cluster are scattered both within and outside the city. Some of larger geographical concentration of foundry units are; Aji and surrounding Bamanbore, Kuvadwa and Manda Dungar, Shapar and surrounding Atika, Samrat and Vavdi and GIDC Lodhika (Metoda) areas. These areas have been depicted in figure.

Major concentrations of foundries in Rajkot

Based on their production levels, pump-set units can be categorised under A, B and C categories as follows:

Category A (large) – Average production level: 3,500 pump-sets per month
Category B (medium) – Average production level: 1,000 pump-sets per month
Category C (small and micro)– Average production level: 500 pump-sets per month

About 50 pump-set units fall under category A, 200 in category B and balance in category C. The production of pump-set of the cluster is about 30,000 pump-sets per day (about 9.0 million pump-sets per annum). The pump-set industry employs about 35,000 direct employees. The estimated turnover of the pump-set units in the cluster is nearly Rs 10,000 crore per annum.

The raw materials for pump-set industry are mainly castings, sheet-metal and rods. Castings are procured locally from foundry units and other raw material is procured from local and national market.

The motors of submersible pumps can be either water-filled or oil-filled. Oil-filled motors are capable of operating at low voltages. Almost 80% of the submersible pumps produced in Rajkot are of water-filled type. Four main categories of submersible pump sets are produced in Rajkot: V3 (i.e. for 3-inch bore well), V4 (for 4-inch bore well), V6 (for 6-inch bore well) and V8 (for 8-inch bore well). The power rating of the electrical motor in commonly produced pumps ranges from a few horsepower (hp) up to 10 hp. The most common models produced are V6 8 stage (7.5 hp) and V6 10 stage (10 hp) radial flow pumps. The former models are capable of delivering 350–400 litres of water per minute from a depth of 96 m; the latter, from a depth of 120 m. For arid regions where the water table is very low, large diameter models such as V8 and even V10 (for 10-inch bore well) are produced, with power ratings that can go as high as 100–200 hp.

The pump manufacturers in Rajkot produce pump sets of two different levels of quality: colloquially referred to as 'premium' (or BIS equivalent) and 'commercial' (below BIS quality). According to industry estimates, roughly 50% of the pumps manufactured in the cluster are of commercial quality. There is a market for commercial quality pumps as they are about 30% cheaper than the premium quality models. Also, there is a market for premium quality pumps as they are equivalent in quality to BIS-labelled ones, yet cheaper (due to lower testing and marking fees).

Energy scenario in the cluster

Electricity and diesel are the major sources of energy for the pump-set units. Electricity is supplied by Paschim Gujarat VIJ Company Ltd (PGVCL) and diesel is procured from local market. Electricity is used for running all machinery and diesel is used in DG-set in case of emergency during unscheduled power outage. The details of major energy sources and tariffs are shown in table.

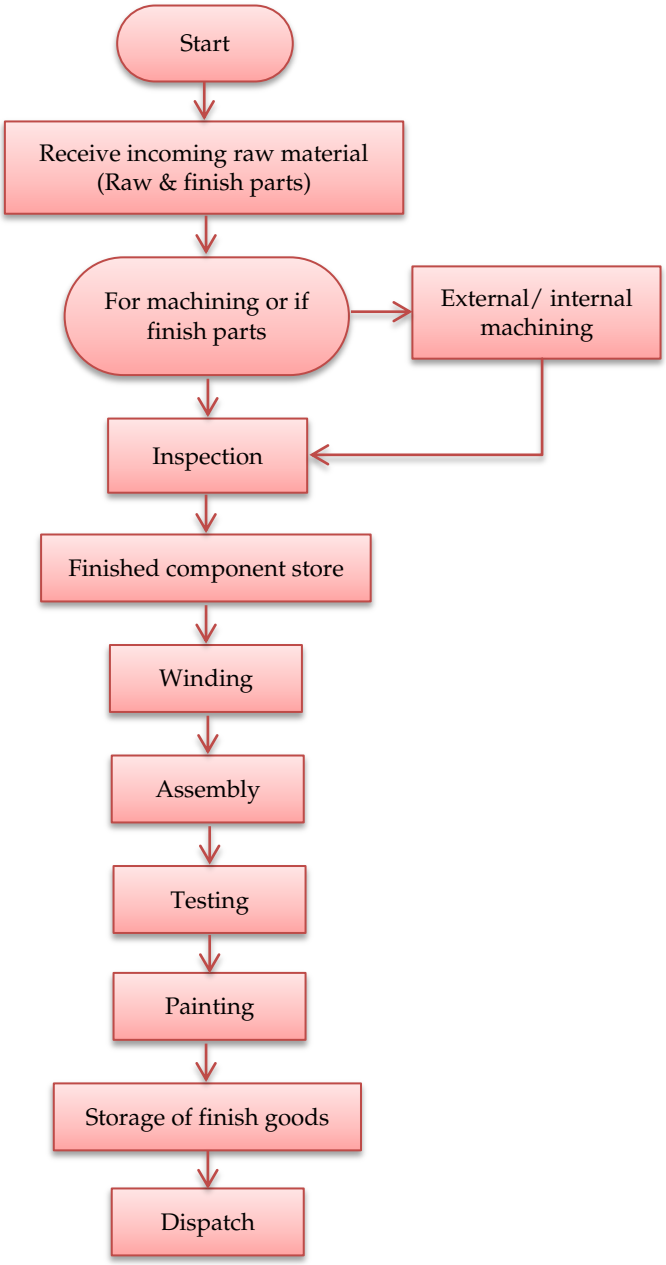
Prices of major energy sources

Source	Remarks	Price
Electricity	HT	Rs 8.00 per kWh (inclusive of energy, demand charges, other penalty/rebate and electricity duty)
	LT	Rs 9.00 per kWh (inclusive of energy, demand charges and electricity duty)
Diesel	From local market	Rs 55 per litre (price subjected to market fluctuations)

Production process

The major steps of process are mould sand preparation, charge preparation followed by melting, pouring, knockout and finishing. The steps are explained below.

1. **Raw material inspection**. The raw materials received from foundries, machine shops are inspected against specifications. The castings which are not acceptable are rejected, remaining pieces are sent forward. In other shop the motor rotor and stator components are inspected.
2. **Machining.** The castings are sent to machining section. The large and medium units use CNC and VMC machines and have control of operations. Small and micro units do conventional machining and inspection is done by using gauges manually.
3. **Winding.** The copper coils are tested for continuity, resistance and high voltage before going for coiling. Coils could be insulated by a plastic layer or by dipping coil in an epoxy resin bath. The coils are dried in an electrical oven. Once tested 'okay', the stator and rotor part are wound with copper coil either manually or using automated machines.
4. **Assembly.** The stator and rotor part of motor are assembled carefully and housed in motor body. In other shop the pump components such as impeller, bearings, pump casing, discharge nozzle are assembled. The motor and pump sections are assembled into one pieces by mechanical coupling and housed in a single casing. Prior to assembly some components such as rotor shaft are heat treated for improving strength and properties. Heat treatment furnace is not available with all units, most of them get it done from ancillary units.
5. **Testing.** Once assembled, the pump-set is subjected to a performance test to verify its operation head, flow range and power consumption. The tests are to verify, if the pump operates in range of its design specifications. Not all units have sophisticated testing facility.
6. **Painting.** The pump-set is painted in a paint shop, most units adopt spray-paint technique. A very few units are using power coating technique for painting.
7. **Storage and despatch.** The finished pump-set is packed in a case and kept in storage for despatch.



A simplified process flow diagram of a typical pump-set unit is given in the figure.

Technologies employed

Some of the major Pump-set processes/equipment are described below.

(i) Machining

CNC machine

The small and micro units are still using conventional manual machining units. The large and medium units use CNC machines. The Computer Numerical Control (CNC) machines can reduce costs, reduce lead times, improve quality, reduce tooling and increase productivity. CNC machines are more expensive than manually operated machines, although costs are slowly coming down. CNC comes in different orientation; horizontal and vertical, units choose them based on application.

(ii) Motor driven hydraulic press

Hydraulic press

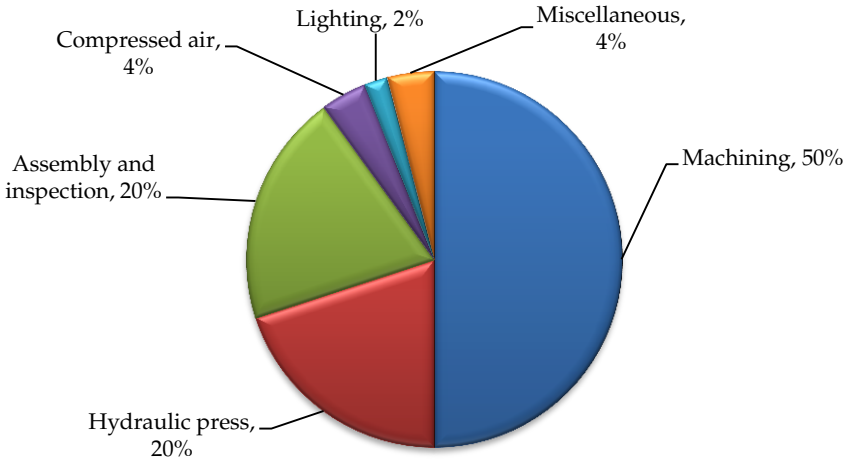
Hydraulic force is used in a number of applications in pump manufacturing process. The motor driven hydraulic machines are available for different force and power ratings. The machines used in small and micro units for making smaller pump-sets are smaller machines ranging from 20 – 60 tons pressure. The large and medium pump-set units use relatively bigger machines ranging from 60 – 300 tones pressure driven by motor of rating 15 – 50 hp.

(iii) Air compressors

Compressed air is used in pneumatic grinders, casting cleaning, and packing and for other miscellaneous uses in a pump-set unit. The connected load of an air compressor size may range from a few kW (single air compressor) for a small and micro scale unit to 30 kW (2 – 3 air compressors) for a medium or large scale pump-set unit.

Energy consumption

Pump-set uses electricity for running all the machinery. Machining accounts for a major share of about 50% of total energy followed by hydraulic press, which consume about 20%. The other important energy consuming areas include assemble, inspection, lighting and miscellaneous. The share of energy usage in a typical small and medium pump-set is given in the figure.



Typical energy use in a pump-set unit

(i) Unit level consumption

The specific energy consumption (SEC) varies considerably in a pump-set unit depending on the type of pump-set manufactured and degree of mechanisation in unit. On an average the electrical energy consumption per pump-set varies between rupees two to six. Typical energy consumption of a pump-set unit is given in table.

Typical energy consumption in induction furnace based Pump-set units

Production (pump-sets/month)	Electricity (kWh/year)	Total energy (toe/year)	Annual energy bill (million INR)
500	30,000	2.6	0.27
1000	60,000	5.2	0.48
3500	2,00,000	17.2	1.60

(ii) Cluster level consumption

The overall energy consumption of cluster is about 6,200 tonnes of oil equivalent per annum. The energy consumption pattern in the cluster is given in table.

Energy consumption of the Rajkot Pump-set cluster (2014-15)

Energy type	Annual consumption	Equivalent energy (toe)	Annual energy bill (million INR)
Electricity	70 million kWh	6,020	600
Thermal (Diesel)	170 kilo litre	170	10
	Total	**6,190**	**610**

Energy saving opportunities and potential

Some of the major energy-saving opportunities in the pump-set units in the cluster are discussed below.

(i) Replacement of existing conventional machining with CNC machines

A large number of units use conventional machining. It is manual process and leads to larger error and it is difficult to get precision with consistancy, thus leading to higher rejections. Replacing them with CNC machines would bring down rejection drastically, it will also improve production efficiency. The capital investment in the CNC machine will have a payback period of about four years.

(ii) Energy efficiency improvement in hydraulic press

A number of steps are possible for energy efficiency improvement in hydraulic presses depending up on type of operation and degree of control. Such recommendations includes: soft starter with on-load capacitor bank, retrofitting motor with variable frequency drive.

(iii) Reduction in rejections

A large number of units have high rejection level, which can be brought down to below 5% through improved process control. This can be achieved with no or marginal investments.

(iv) Retrofitting air compressor with variable frequency drive

During normal operation, an air compressor operated on unloading position for more than half the time. Installation of variable frequency drive (VFD) to the air compressor will minimise the unload power consumption. The investment for VFD will have simple payback period of about one to two years.

(v) Arresting the compressed air leakage

Compressed air is an expensive utility in a plant. However, in most cases, air leakages in piping system are quite high (above 15%) and go unnoticed. The compressed air leakage can be brought down to about 5% with good housekeeping practices. The unit can save a considerable amount of energy by controlling compressed air leakages with no investment.

(vi) Reduction in pressure setting of air compressor

The pressure setting of air compressors are often much higher than the actual air pressure requirement in the plant. The typical unload and load pressure settings are 8.0 and 7.0 bar respectively. Reducing the compressed air pressure as per end-use requirements will result in high energy savings. Reduction of generation pressure by one bar can lead to energy saving of 6%.

(vii) Replacement of rewound motors with energy efficient motors

Rewinding of motors result in a drop in efficiency by 3-5%. It is better to replace all old motors which has undergone rewinding three times or more. The old rewound motors may be replaced with EE motors (IE3 efficiency class). This would results into significant energy savings with simple payback period of two to three years.

Major stakeholders

Industry associations

There are several industry associations in Rajkot pump-set cluster. The major industry associations, related to pump-set industry, are the following:

(i) Rajkot Engineering Association

Rajkot Engineering Association (REA) is the apex industry association for engineering industry in Rajkot and has a membership of over 1600 industrial units. The association was incorporated in 1963 with an objective of extending help to its members for the promotion and development of its manufacturing activities. The association also supplies raw materials like pig iron to its members on 'no-profit-no-loss' basis. The association is centrally located in Bhaktinagar Industrial Area of Rajkot and has its own building and conference facilities. It regularly arranges meetings, seminars and workshops for its members. It publishes a monthly 'Information Bulletin' in Gujarati to communicate with its members on a regular basis.

(ii) Institute of Indian Foundrymen (IIF), Rajkot Chapter

The IIF, Rajkot Chapter is active in promoting information exchange and networking among foundry industries in the cluster. It works closely with REA and is also located within the association premises.

(iii) GIDC (Lodhika) Industrial Association (GLIA)

GLIA was established in 1996 in GIDC (Lodhika) Estate. The estate was setup by Gujarat Industrial Development Corporation in 1990 and has about 1000 member industries consisting of engineering, plastics, packaging, food-processing, building material, pharmaceutical, cold storage, etc. There are about 50 foundry units located within this estate.

(iv) Aji GIDC Industries Association.

Aji GIDC is one of the oldest industrial estates established 40 years before. The industrial estate covers an area of about 270 acres and has about 80 foundry units.

(v) Shapar Veraval Industrial Association (SVIA)

SVIA includes various types of industries ranging from investment castings, plastics and packaging, auto parts, engineering, bearings, brass parts, kitchenware and so on. There are almost 300 foundries located Shapar Veraval and surrounding areas.

The District Industries Centre (DIC), Rajkot provides several incentives to MSMEs like capital investment subsidy, interest subsidy, venture capital quality certification, energy and water audits and so on. There is a branch office of the MSME Development Institute, Ahmedabad in Rajkot.

Cluster development activities

The industry associations in the cluster are active in networking and outreach activities. A centre has been established several years before by the National Small Industries Corporation Ltd (NSIC) in Rajkot which. The centre used to offer many courses. However, most of the courses were discontinued and the existing facilities in the centre are being used sub-optimally at present. The centre mainly focuses on testing of materials and pump sets and vendor registration services for MSMEs. Vendor certification is mandatory for submitting quotation for DGS&D (Directorate General of Suppliers & Disposal) government rate contracts. A testing laboratory of CMTI (Central Manufacturing Technology Institute), Bangalore, has been established within the campus with assistance under the UNIDO a few years back.

A 'common facility centre' (CFC) is coming up that would have testing facility for pump sets and foundry materials. The CFC was conceived by TERI and REA in 2010 in order to cater to the needs of local pump manufacturers who were facing difficulties obtaining BIS certification due to long delays in testing of their products. A Special Purpose Vehicle (SPV) named 'Rajkot Engineering, Testing and Research Centre' was formed with the partnership of local industry, state and central government; and land for the CFC was provided by REA. The CFC project, with a total cost of about Rs 7.2 crores, was approved in March 2014. Over Rs 74 lakhs was contributed by 62 local industries; Rs 3.82 crores by the central government towards testing equipment; and Rs 2.45 crores by the state government towards the building.

About TERI

A dynamic and flexible not-for-profit organization with a global vision and a local focus, TERI (The Energy and Resources Institute) 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.

The Industrial Energy Efficiency Division of TERI works closely with both large industries and energy intensive Micro Small and Medium Enterprises (MSMEs) to improve their energy and environmental performance.

About SDC

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Swiss Agency for Development and Cooperation SDC

SDC (Swiss Agency for Development and Cooperation) has been working in India since 1961. In 1991, SDC established a Global Environment Programme to support developing countries in implementing measures aimed at protecting the global environment. In pursuance of this goal, SDC India, in collaboration with Indian institutions such as TERI (The Energy and Resources Institute), conducted a study of the small-scale industry sector in India to identify areas in which to introduce technologies that would yield greater energy savings and reduce greenhouse gas emissions. SDC strives to find ways by which the MSME sector can meet the challenges of the new era by means of improved technology, increased productivity and competitiveness, and measures aimed at improving the socio-economic conditions of the workforce.

About SAMEEEKSHA

SAMEEEKSHA (Small and Medium Enterprises: Energy Efficiency Knowledge Sharing) is a collaborative platform set up with the aim of pooling knowledge and synergizing the efforts of various organizations and institutions— Indian and international, public and private—that are working towards the development of the MSME sector in India through the promotion and adoption of clean, energy-efficient technologies and practices. The key partners are of SAMEEEKSHA platform are (1) SDC (2) Bureau of Energy Efficiency (BEE) (3) Ministry of MSME, Government of India and (4) TERI.

As part of its activities, SAMEEEKSHA collates energy consumption and related information from various energy intensive MSME sub-sectors in India. For further details about SAMEEEKSHA, visit http://www.sameeeksha.org