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Cluster Profile Report

Ahmedabad Chemical Cluster

Prepared for

Bureau of Energy Efficiency (BEE)
Ministry of Power, Government of India
New Delhi

THE ENERGY AND RESOURCES INSTITUTE
Creating Innovative Solutions For A Sustainable Future

ENERGY AGRICULTURE ENVIRONMENT HABITAT RESOURCE SECURITY CLIMATE HEALTH & NUTRITION

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List of abbreviations

APM	Administered Pricing Mechanism
BEE	Bureau of Energy Efficiency
BoB	Bank of Baroda
CAGR	Compound Annual Growth Rate
VIA	Vatva Industries Association
CFC	Common Facility Centre
DIC	District Industries Centre
DPR	Detailed Project Report
UGVCL	Uttar Gujarat Vij Company Limited
EE	Energy Efficiency
FI	Financial Institute
NIA	Naroda Industries Association
GHG	Greenhouse Gas
GESCSL	Green Environment Services Cooperative Society Ltd
GoI	Government of India
HT	High Tension
ID	Induced Draft
IDBI	Industrial Development Bank of India
KPI	Key Performance Indicators
LSP	Local Service Provider
LT	Low Tension
MoEF	Ministry of Environment and Forests
MS	Mild Steel
MSME	Micro Small and Medium Enterprises
MSME-DI	MSME-Development Institute
MT	Million Tonnes
NG	Natural Gas
TFH	Thermic Fluid Heaters
OBC	Oriental Bank of Commerce
PNB	Punjab National Bank
PNG	Piped Natural Gas
SBI	State Bank of India
SCM	Standard Cubic Metre
SIDBI	Small Industries Development Bank of India
SWOT	Strengths Weaknesses Opportunities and Threats
TERI	The Energy and Resources Institute
toe	Tonnes of Oil Equivalent
TTZ	Taj Trapezium Zone
UBI	Union Bank of India
WHR	Waste Heat Recovery

Acknowledgements

The Energy and Resources Institute (TERI) is grateful to the Bureau of Energy Efficiency (BEE) for its progressive management and also for vesting its confidence in TERI to carry out this prominent assignment "Energy and Resource Mapping of MSME Clusters in India (Chemical Sector)" and providing full-fledged coordination and support throughout the study.

The study team is thankful to the officials of Vatva Industries Association (VIA) and Naroda Industries Association for showing keen interest in the study and providing their wholehearted support and cooperation for the preparation of this cluster profile report. We would like to extend our special thanks to Mr Ankit S, Patel, President, VIA, Mr Dimple V. Patel, Vice president, VIA, Mr Bharatbhai Patel, President, NIA and Mr. Ajay Patel, Secretary, NIA.

Last, but not the least, interactions and deliberations with MSME-DI, Ahmedabad, Green Environment Services Co-op. Soc. Ltd. (GESCSL), industries associations, Micro Small and Medium Enterprise entrepreneurs, technology providers, and who were directly or indirectly involved throughout the study were exemplary and the whole experience was a rewarding one for TERI.

TERI Team

Certificate of originality

This is to certify that this report is an original work of TERI. The TERI team held detailed discussions and collected data from numerous industry stakeholders, which included MSME entrepreneurs, senior plant engineers, industries associations, local energy distribution companies, key local bodies, local service providers, suppliers, fabricators, experts, testing labs, effluent treatment plants, academic institutes/ ITIs, and banks/FIs. In addition to this, the team reviewed secondary literature available in the cluster. The cluster profile is an end product of both first hand interactions/data and secondary literature in the cluster. Appropriate references have been indicated in places where TERI has utilized secondary sources of data and information.

Chapter 1

1.0 About the Project

1.1 Project overview

The Micro, Small and Medium Enterprises (MSME) sector in India is a unique mix of enterprises using conventional as well as modern technologies. Most of the enterprises in the MSME sector are traditional and deploy technologies that are inefficient and resource intensive. The MSMEs are generally located as clusters. There are many such clusters which are highly energy intensive in their operations.

At national level, the data/information of energy intensive MSME sectors on various parameters like production, type and quantity of fuel consumption, energy saving potential, details on energy efficient technologies, future growth scenarios, etc. are not readily available. This in a way limits the design of appropriate policy instruments to ensure sustainable growth of these sectors. To address this barrier, the Bureau of Energy Efficiency (BEE), Ministry of Power, Government of India, has initiated an ambitious project of mapping the energy intensive MSME sector across the country. Chemical industry is one of the energy intensive sectors identified under the project. The BEE has entrusted The Energy and Resources Institute (TERI), New Delhi to undertake a detailed study of the chemical industry sector in India.

1.2 Project objectives

The objectives of the study include the following:

- Map energy intensive Chemical manufacturing sector from energy perspective
- In-depth study of existing scenarios on energy consumption and identify opportunities for energy and resource saving
- Prepare a roadmap to develop the intervening sector energy and resource efficient as well as environment friendly

The five targeted Chemical clusters covered under the project are shown in table 1.2:

Table 1.2: Targeted clusters under the project

S. No.	Cluster	State	Sector
1	Ahmedabad	Gujarat	Chemical
2	Karnal	Haryana	Chemical
3	Thane	Maharashtra	Chemical
4	Vapi	Gujarat	Chemical
5	Jamshedpur	Jharkhand	Chemical

1.3 Major components of the project

The major components of the project and their activities are shown in Table 1.3.

Table 1.3: Major component of the project

Components	Major activities
Component-1: Field study and data analysis	• Conduct detailed energy audits covering 10 representative units in each cluster • Conduct benchmark study to develop Key Performance Indicators (KPI) and Energy Efficiency (EE) benchmarks • Develop a sectorial profile for the Chemical sector • Develop sectorial brochure
Component-2: Development of roadmap and outreach	• Prepare and publicize sectorial roadmap for Chemical industry • Disseminate outreach and knowledge through; ○ Cluster level workshops ▪ Project inception workshops ▪ Post activities workshops ○ National workshops ▪ Stakeholder consultation ▪ Result dissemination

Chapter 2

2.0 Cluster Scenario

2.1 Background

The chemical industry is an integral constituent of the growing Indian Industry sector and ranks 6th in the world in chemicals sales. India is a leading dyes supplier at a global level and account[1] for about 16% of the world's production of dyestuff & dye intermediates. The chemical industry accounted for 1.34% of the "gross value added" (GVA) during 2018-19. This sector is highly diversified (Figure 2.1) and comprises both MSMEs as well as large scale units (including multi-national companies).

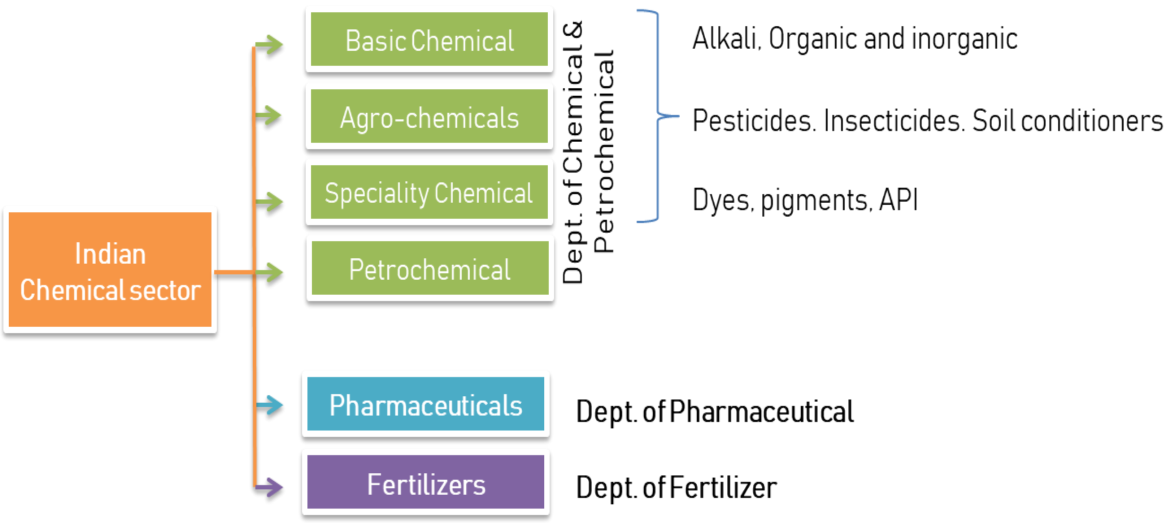

Figure 2.1: Classification of Indian Chemical sector

The chemical industry covers more than 80,000 commercial products[2]. It includes basic chemicals and its products, petrochemicals, fertilizers, paints, varnishes, gases, soaps, perfumes and toiletry, and pharmaceuticals. The industry occupies a pivotal position in meeting basic needs and improving the quality of life. It is the mainstay of industrial and agricultural development of the country and provides building blocks for several downstream industries, such as textiles, papers, paints, varnishes, soaps, detergents, pharmaceuticals, etc.

[1] https://www.investindia.gov.in/sector/chemicals

[2] As per National Industrial Classification (NIC) 2008, Chemical & Chemical products are covered under the industry division 20

The Indian chemical industry employs more than 20 lakh people[1]. Three independent departments, under the Ministry of Chemicals & Fertilizers Government of India, are responsible for the growth of the respective sub-sectors which include (1) Department of Chemicals and Petrochemicals, (2) Department of Fertilisers, and (3) Department of Pharmaceuticals.

The state of Gujarat is leading state in the manufacturing of chemicals, petrochemicals, and pharmaceutical in the country. The other major Indian states involved in the production of chemicals include Maharashtra, Tamil Nadu, and Uttar Pradesh.

2.2 Overview of Ahmedabad Chemical cluster

Ahmedabad chemical cluster is one of the important chemical clusters in Gujarat. The cluster houses a number of large scale and MSME units, manufacturing various types of chemical products. There are about 750 dyes and chemical manufacturing units in Ahmedabad cluster. All these chemical manufacturing units are located in Vatva, Naroda and Odhav industrial areas. There are about (i) 600 chemical units in GIDC, Vatva, (ii) 100 units in GIDC, Naroda and (iii) 50 units in GIDC, Odhav. Most of these manufacturing units are operational for the last 20 years.

Some of the leading large scale industries and multinational companies like Bodal Chemicals Ltd, Kiri Industries Ltd, Meghmani Dyes And Intermediates Ltd, Meghmani Organics Ltd, Nirma Ltd, Asahi Songwon Colours Ltd, Jay Chemical Industries Ltd, etc. are also located in Ahmedabad. The annual turnover of chemical industries in Ahmedabad cluster is more than Rs 11,000 crore. The cluster provides employment to about 2 lakh people, of which 80% are locals and the rest are from other states of India[3].

2.2.1 Classification of Chemical units

The chemical units in Ahmedabad cluster can be classified either on the basis of the type of products or production capacities. About 80% of the total units in the cluster produce dyes and dye intermediates while rest of the units are involved in production of other chemicals (organic and inorganic chemicals). On the basis of production capacity, about 76% of chemical units fall under the "small" enterprise category with production capacity of 200-600 tonne per year while 5% of the total unit fall into the "medium" sized enterprise category (figure 2.2.1).

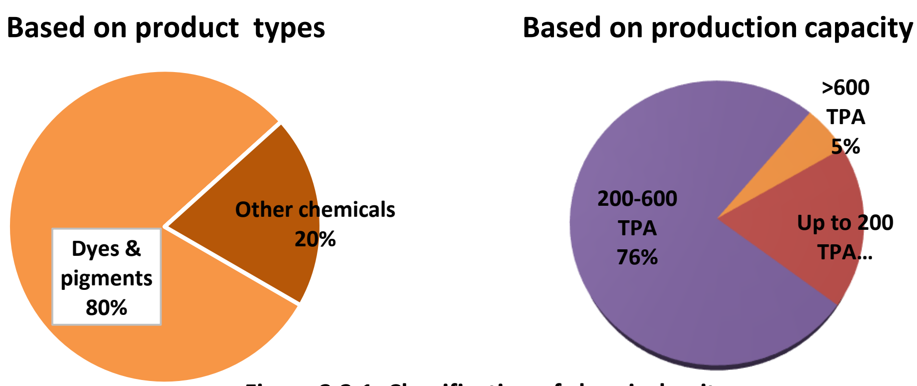

Figure 2.2.1: Classification of chemical units

[3] Business Standard, 2019

2.2.2 Major products

The chemical industries in the Ahmedabad cluster manufacture a diverse range of products like dyes and dye intermediates, pigments, pesticides/ insecticides, agrochemicals, paints, etc. Some of the major categories of chemicals produced in the cluster are shown in Table 2.2.2.

Table 2.2.2: Chemical products manufactured in Ahmedabad cluster

Category	Products
Dyes and pigments	Azo dyes, acid direct dyes, basic dyes, fats colour bases, oil - based dyes, whitening agents, organic pigment colours, pigment emulsion, food colours
Other chemicals (Inorganic)	Aluminium fluoride, calcium carbide, carbon black, potassium/sodium chlorate, titanium dioxide, and red phosphorous
Other chemicals (organic)	Acetic acid, Acetone, Acetic anhydride, phenol, methanol, nitrobenzene, citric acid, chloromethane, aniline

2.2.3 Market scenario

The chemical units of Ahmedabad find customers in both domestic and international markets. Textile sector is a major consumer of dyestuffs. Reactive dyes, vat dyes & azo dyes are mainly required for dyeing and printing of cotton fibres. Disperse dyes are consumed for dyeing the synthetic fibres. Acid dyes are used in leather and woollen product industries. Many special dyes & pigments are used in printing inks. Most of the micro units located in Ahmedabad sell their produce to large pharmaceutical and agro-chemical industries located in Ahmedabad itself.

Major exports of dyes are to developed countries like Germany, UK, USA, Switzerland, Spain, Turkey, Singapore and Japan. Exports of Dyes to Latin American and African Countries have also started picking up. The chemical units which have acquired international quality and environment certifications are exporting speciality chemicals, inorganic chemicals, and pigments to European countries, parts of North America, Australia, Singapore, Taiwan, Thailand, Africa, and Bangladesh.

2.2.4 Raw materials

A variety of basic chemicals are used as raw materials to manufacture major chemical products. These basic chemicals are based on different factors such as chemical composition (organic and inorganic), origin of chemicals (mineral, vegetative, and animal), and state of aggregation (solid, liquid, and gaseous).
The types of mineral raw materials include ore (metallic), non-metallic, and combustible (organic). Ore minerals primarily comprise metal oxides and sulphides (Cu_2S, CuS, Fe_2O_3, Fe_3O4, ZnS, and so on). It also includes SiO_2, Al_2O_3, CaO, and MgO. Non-metallic raw materials are diverse in chemical composition and are used either in their natural state (sand, clay, asbestos, and mica) or are delivered for chemical processing (chloride, phosphates, sulphates, carbonates, and alumina silicates). Apart from that various types of organic inorganic acids like (H-acid, HVS, nitric acid, Chlorosulphonic acid, vinyl sulphonate acid etc.) are also used on a large scale especially in dyes and dye intermediates. Vegetative and animal raw materials include wood, cotton, oils and fats, milk, hides, and wool. They are processed either into food products (food raw materials) or into products for domestic and industrial use. Majority of these raw materials are sourced locally.

2.2.5 Cluster level initiatives

The programmes and initiatives undertaken by various organisations are listed in the table 2.3

Table 2.2.5: Chemical level initiatives

Organisation	Programme/initiatives	Brief description	Status
Vatva Industries Association (VIA)	Common effluent treatment plant (CETP)	Green Environment Services Co-op. Soc. Ltd was established in 1992. Presently it has more than 600 member units	Operational
Vatva Industries Association (VIA)	Centre of Excellence	Developed under IIUS Scheme, 2003 with support from Government of India	Operational
Bureau of Energy Efficiency (BEE)	BEE SME National Programme	Situation analysis, cluster profiling, energy audits and bankable detailed project reports (DPRs) on EE technologies	Implemented during 2009-2012
Gujarat Pollution Control Board	Sustainable manufacturing	Up to INR 75 lakh for Zero Liquid Discharge plants: 50% of capital subsidy up to INR 75 lakhs will be given to industries practicing at least 50% waste recovery through Zero Liquid Discharge as certified by GPCB.	Operational

Chapter 3

3.0 Major cluster stakeholders

The primary stakeholder of the cluster is the chemical manufacturing units. The other stakeholders include industry associations, government agencies including regulatory bodies, research and academic institutions, and testing facilities and training institutes. These cluster level stakeholders provide a range of services to the chemical manufacturing units. Some of the major stakeholders in Ahmedabad chemical industry cluster along with their roles and activities are briefed below.

3.1 Industries associations

There are two major industry associations active in Ahmedabad chemical cluster. The contact details of the industries associations are given in table 5.

3.1.1 Vatva and Naroda Industries Association

Vatva Industries Association (VIA) and Naroda Industries Association (NIA) have been playing a key role in accelerating the growth in the GIDC estate of Vatva and Naroda. VIA and Naroda has more than 2,000 member units. Some of the key activities include (i) redressal of grievances of member industries, (ii) infrastructural development, (iii) provide guidelines to members to fulfil on legal requirements and green belt development, and (iv) environmental preservation and pollution control.

3.1.2 Gujarat Dyestuffs Manufacturer's Association

Gujarat Dyestuffs Manufacturers' Association (GDMA) has membership of more than 1,100 units located in Ahmedabad and other clusters in Gujarat. The key activities of GDMA include (i) environmental preservation and pollution control, and (ii) creating awareness through publications.

Table 3.1.2: Contact details of industries associations

Name of association	Contact details
Vatva Industries Association	Centre of Excellence Building, Plot No. 511, Phase – IV, GIDC Estate, Vatva, Ahmedabad – 382 445, Gujarat Email: info@vatvaassociation.org Website: www.vatvaassociation.org Contact person: Mr Ankit S Patel (President)
Naroda Industries Association	184-A/1 Gidc Estate Phase 1, Sheth Shantilal Kapasia Hall, Naroda Gidc, Ahmedabad – 382330 Website: http://narodaassociation.org Contact person: Mr Ajay S Patel (Secretary)
Gujarat Dyestuffs Manufacturers' Association	KARMA, 8th floor, Opp. Mahalaxmi Muni. Market, Paldi, Ahmedabad - 380 007, Email: info@gdma.org Website: http://www.gdma.org/ Contact person: Mr Yodesh D Parikh (President)

3.2 Government bodies

The government agencies involved in the cluster and their key activities in the cluster are given in table 3.2.

Table 3.2: Government bodies and key responsibilities

Name of organisation	Key roles
Gujarat Industrial Development Corporation (GIDC)	• Identify the new entrepreneurs and assist them regarding their start-ups. • Assist smaller blocks for industrialization at the district level. • Enhance the rural industrialization and also the development of handicrafts. • Reach economic equality in multiple areas of the district. • Allow various government schemes to the new entrepreneurs. • De-size the regional imbalance of development. • Make all the necessary facilities to come under one roof
District Industries Centre (DIC)	• MSME-DIs field offices of the Ministry of Micro, Small & Medium Enterprises provide a wide range of extension/ support services to the MSMEs in their respective state of operation.

3.3 Technical, academic, and R&D institutions

Both public and private testing laboratories are available in Ahmedabad and surrounding GIDC estates. Some of the major engineering and polytechnic institutes like Institute of Technology, Nirma University, and LJ Institute of Engineering and Technology offer a variety of courses in chemical engineering and chemical industry technologies relevant for the cluster. These institutes provide technical workforce to the cluster. A number of Industrial Training Institutes (ITIs) in Ahmedabad district offer industrial training courses like chemical plant operators, laboratory attendants, chemists, process attendants, and ETP operators etc.

3.4 Financial institutions

There are about 25 nationalized, commercial, and cooperative banks operating in the cluster. Some of the important banks in the cluster include Bank of Baroda (BOB), State Bank of India, Axis Bank, Vijaya Bank, Punjab National Bank, ICICI Bank, HDFC Bank, and Dena Bank. The Ahmedabad branch of SIDBI is serving the Chemical industries of GIDC Vatva and GIDC Naroda. Most of these banks provide financial assistance towards expansion and infrastructural upgradation of chemical units. In addition, a large number of cooperative banks also operate in the cluster to meet the financial requirements of the cluster.

Table 3.4: Details of Bank in Ahmedabad cluster

Sr. No	Bank Name	Bank Address
1	Bank of Baroda	Post Box No. 101, Fuvara, Gandhi Road, Ahmedabad
2	State Bank of India	Dibiyapur, Phase 2, GIDC Vatwa, Ahmedabad
3	United Bank of India	Dibiyapur, Phase 2, GIDC Vatwa, Ahmedabad
4	ICICI Bank	Phase I, GIDC Vatwa, Ahmedabad
5	Bank of India	Phase I, GIDC Vatwa, Ahmedabad
6	Punjab National Bank	Phase I, GIDC Vatwa, Ahmedabad
7	Small Industries Development Bank of India	Isanpur Ghodasar Highway, Isanpur, Ahmedabad
8	Syndicate Bank	Reliance Industries Ltd Premises, opp. Gate No.1, Naroda, Ahmedabad

Chapter 4

4.0 Production process and technology use

4.1 Manufacturing process

The manufacturing process of the chemical industries varies widely depending on the type of products. The generic production of chemicals involves dissolving of raw materials, filtration, purification, drying and classification. A brief description of various processes followed in a typical chemical manufacturing unit is provided in this section and the same is represented in Figure 4.1.

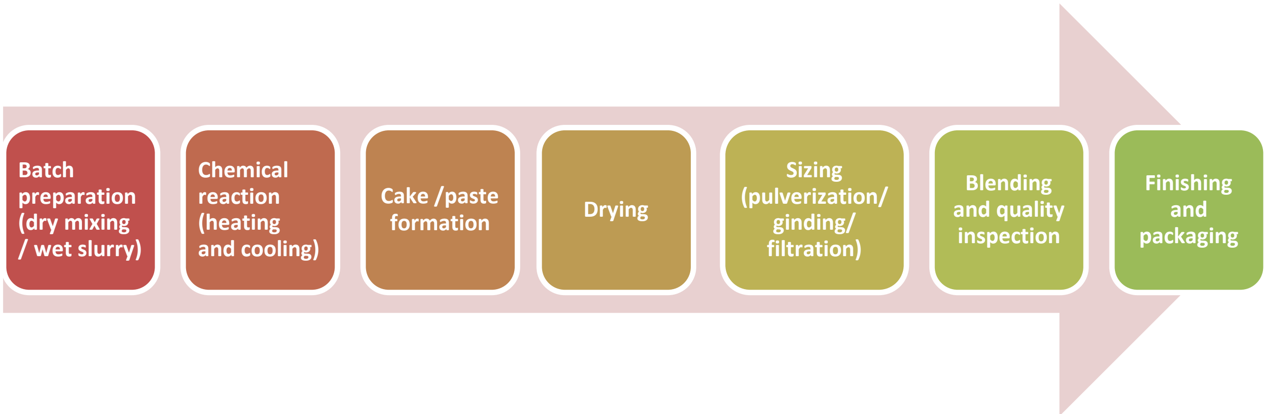

Figure 4.1: Process flow in a typical chemical manufacturing unit

4.1.1 Batch Preparation

The raw materials in the desired proportion by weights are poured into reaction vessel. The mixture is continuously stirred; as per the specific requirement of the product, the temperature is maintained using jacket heating/ cooling arrangement. The overall processing time in the reaction vessel depends on the desired output in terms of temperature or intermediate product concentration. The process uses both thermal energy and electricity. The thermal energy requirement is met through a boiler or thermic fluid heater (TFH).

4.1.2 Primary Filtration

After mixing, the intermediate products i.e. liquid and/or suspended solid particles are separated from the slurry. The filtration is carried out using centrifuge or filter press. This process takes about 1–2 hours for completion.

4.1.3 Purification

Purification helps in improving or modifying the basic properties of the intermediate product as per the requirement of final product. For example, to neutralise the alkaline natured intermediate product, sulphuric acid is added in the intermediate product and the desired temperature is maintained using jacket cooling/ heating. The product is continuously stirred using an agitator system.

4.1.4 Secondary filtration

In secondary filtration process, the intermediate product is separated from the slurry using a centrifuge or filter press. The secondary filtration process takes about 1-2 hours for completion.

4.1.5 Drying

The drying process is generally applicable for organic chemical products in which the final product is of powder form. The cakes from filtration process are loaded into tray/ spin flash dryers for removal of moisture and drying using hot air. Drying is thermal energy intensive and most time-consuming process and takes about 20–36 hours per batch. The hot air is supplied by natural gas or wood-fired hot air generator.

4.1.6 Grinding/crushing (Pulverization)

The granules/ blocks of dried products are crushed or ground in a pulverizer, as per the desired particle size of the final product. The process takes about 3–5 hours per batch.

4.2 Major technologies and equipment

A variety of chemical products like dyes, pigments, paints, agro-chemicals, and pharmaceutical products are manufactured in Ahmedabad cluster. However, the technology use and type of process equipment used in manufacturing of these chemicals are quite similar. The major technologies and equipment used in process areas and utility sections are provided in table 4.2.

Table 4.2: Major technologies/equipment used in chemical industries

Manufacturing process	▪ Reaction vessels ▪ Centrifuge ▪ Press filter ▪ Dryers (Tray dryer, spray dryer, spin flash dryers) ▪ Ball mills
Auxiliaries/utilities	▪ Steam boilers ▪ Thermic fluid heaters ▪ Hot air generators ▪ Air compressors ▪ Chilling system

4.2.1 Details of process equipment

The brief details of the equipment used in the manufacturing processes are provided below.

4.2.1.1 Reaction vessels/kettles

The chemical reactions take place in kettles, primarily made of stainless steel or rubber lined ceramic material. The chemical units have different capacities of reaction vessels varying in the range of 1-20 kilo litre (kL). The capacities and number of vessels in a chemical unit are dependent on type of manufacturing process, production capacity and batch size.

4.2.1.2 Centrifuge

The intermediate products in the form of slurry (suspended solid particles) are separated from the slurry using centrifuge. Different basket sizes of centrifuge e.g. 24/36/48 inch are used in the cluster.

4.2.1.3 Press filter

In this section, the solid particles and liquid chemicals are separated by pressing the slurry in filter plates using hydraulic force. The separation occurs in chambers formed between the recessed faces of filter plates, which are clamped together in a rugged steel frame. Compressed air at about 5–7 kg/cm^2 is used to remove liquids from pores in the filter cake. Upon reaching the desired residual moisture content, the filter is opened and the cake is removed. The filter press helps in reducing the moisture content by 50% to 60%.

4.2.1.4 Dryers

The moisture-laden solid cakes are kept in the dryer chamber and heated to the required temperature to remove the moisture. A wide range of dryers are used namely tray dryer, fluidized bed dryer, rotary vacuum dryer, and spin flash dryer. Steam boilers, thermic fluid heaters, and hot air generator are used for providing heating requirements in the dryer.

4.2.1.5 Ball mills

The granules/ blocks of dried products are crushed as per the desired particle size of the final product with the help of a ball mill. A ball mill consists of a hollow cylindrical shell rotating about its axis. The axis of the shell may be either horizontal or at a small angle to the horizontal. It is partially filled with balls. The grinding media are the balls, which may be made of steel (chrome steel), stainless steel, ceramic, or rubber. The inner surface of the cylindrical shell is usually lined with an abrasion-resistant material such as manganese steel or rubber lining. Less wear takes place in rubber lined mills. The length of the mill is approximately equal to its diameter.

4.2.2 4.2.2 Details of auxiliaries equipment

The brief details of auxiliaries/utilities used in the chemical industries are provided below.

4.2.2.1 Steam boilers

The steam boilers, as per Indian Boilers Regulations (IBR), are mainly used for low and medium pressure (i.e. 3.5-10.5 kg/cm^2) applications in the chemical units. The natural gas is the major fuel used in boilers to generate the steam. However, some of the micro and small size chemical units also use firewood or coal as in the boilers. Most of the chemical processes require low pressure steam (i.e. 3.5-5.5 kg/cm^2) for jacket heating and direct purging into the reactor vessels. The capacities of IBR type boilers range from 1-5 tonne per hour (tph).

The non-IBR boilers (up to 750 kg per hour evaporation rate) are also used in the chemical units to meet intermittent steam requirements. These boilers are of single pass, once through type and primarily use natural gas or liquid fuels as energy source.

4.2.2.2 Thermic fluid heaters

The thermic fluid heaters (TFH) or thermos-packs are used to cater to the indirect heating requirements of manufacturing processes viz., dryer and jacket heating. The natural gas is mainly used as fuel in TFH. The capacities of thermos-packs vary from 100,000 kcal per hour to 500,000 kcal per hour based on process requirements. The temperature of thermic fluid is about 180-200 °C.

4.2.2.3 Hot air generators

The hot air generators (HAG) are used to generate hot air at about 60-200 °C Based on process requirements. Fans are installed in drying chamber for hot air circulation towards moisture removal. The typical capacities of HAGs used in the cluster vary from 100,000 kcal per hour to 400,000 kcal per hour. While the HAGs use natural gas as fuel, some of the chemical units under micro category use wood fired hot air generators to cater to the heating requirements in tray dryers.

4.2.2.4 Air compressors

The air compressors are used to meet compressed air requirements of processes and pneumatic instrumentation in the chemical units. The end use compressed air pressure varies from 5 kg/cm^2 to 7 kg/cm^2. Most of the chemical units use small capacities tank mounted, reciprocating type air compressors, while some of the progressive units use screw compressors.

4.2.2.5 Chilling system

Some of the chemical units require to maintain the temperature of processes below 0^oC. To meet this process cooling requirements, ammonia type reciprocating chillers are mainly used in these units. The capacity of ammonia based chillers varies from 15 TR to 110 TR. A few chemical units employing intermittent processes use ice blocks instead of chillers for the cooling process.

Chapter 5

5.0 Energy consumption profile and conservation measures

5.1 Details of energy use

The chemical industries in Ahmedabad cluster use both thermal energy and electricity in the manufacturing processes. Energy accounts for a sizeable portion of manufacturing costs of the chemical units of Ahmedabad cluster. The energy costs are 5–7% of the manufacturing costs for inorganic chemicals and about 12–15% for dyes and chemicals. The levels of energy consumption in these units are dependent on the type of products and the process followed. Different types of energy used in the cluster include natural gas, coal, firewood, and electricity.

5.1.1 Thermal energy

Thermal energy is used to meet the heating requirements of the processes followed in chemical industry. The details of thermal energy use in the cluster are provided in Table 5.1.1.

Table 5.1.1: Details of fuels used for thermal energy requirements

Energy type	Source	Calorific value	Landed cost
Natural gas	Adani Gas	8,750 kCal/SCM	Rs 38-42 /SCM
Coal	Local market	4,200-4,800 kCal/kg	Rs 6-8 /kg
Firewood	Local market	2,700-3,200kCal/kg	Rs 3-4 /kg
HSD	Retail outlets		

5.1.2 Electricity

Electricity is used in electric motors to operate utilities such as agitator systems of reaction vessels, centrifuges, various pumps, chilling plants, and air compressors. Most of the micro category chemical units use LT connection, whereas the small and medium category units use HT connection. Electricity is supplied by Uttar Gujarat Vij Company Limited and Torrent Power Limited. The applicable tariff of various such categories is given in Table 5.1.2. and Table 5.1.3.

Table 5.1.2: Electricity tariff plans of Uttar Gujarat Vij Company Limited

Category	Contract demand	Demand Charges	Criteria	Energy Charges
LTMD	For first 40 kW of billing demand	Rs 90 per kW per month		Rs. 4.60 per Unit
	Next 20 kW of billing demand	Rs 130 per kW per month		

Category	Contract demand	Demand Charges	Criteria	Energy Charges
	Above 60 kW of billing demand	Rs 195 per kW per month		
	For billing demand in excess of the contract demand	Rs 265 per kW		
HTP-1	For first 500 kVA of billing demand	Rs 150 per kVA per month	Upto 500 kVA of billing demand	Rs 4 per Unit
	For next 500 kVA of billing demand	Rs 260 per kVA per month	For next 2000 kVA of billing demand	Rs 4.2 per unit
	For billing demand in excess of 1000 kVA	Rs 475 per kVA per month	For billing demand in excess of 2500 kVA	Rs 4.3 per Unit
	For billing demand in excess over the contract demand	Rs 555 per kVA per month		

Table 5.1.3: Electricity tariff plans of Torrent Power Limited

Category	Contract demand	Demand Charges	Criteria	Energy Charges
LTMD	For first 40 kW of billing demand	Rs 65 per kW per month		Rs. 4.35 per Unit
	Next 20 kW of billing demand	Rs 100 per kW per month		
	Above 60 kW of billing demand	Rs 165 per kW per month		
	For billing demand in excess of the contract demand	Rs 210 per kW		
HTP-1	For first 500 kVA of billing demand	Rs 100 per kVA per month	Upto 500 kVA of billing demand	Rs 4 per Unit
	For next 500 kVA of billing demand	Rs 200 per kVA per month	For next 2000 kVA of billing demand	Rs 4.2 per unit
	For billing demand in excess of 1000 kVA	Rs 270 per kVA per month	For billing demand in excess of 2500 kVA	Rs 4.3 per Unit
	For billing demand in excess over the contract demand	Rs 370 per kVA per month		

5.2 Energy consumption pattern

The energy consumption pattern of the chemical units varies based on product type, technology employed and production capacities. The unit level energy consumption of typical production capacities and cumulative cluster level energy consumption of the Ahmedabad chemical industries are summarised below.

5.2.1 Unit level

The energy consumption of typical chemical units in Ahmedabad chemical cluster varies from 15.1 .to 2080.6 tonnes of oil equivalent (toe) per year (Table 5.2.1). Thermal energy accounts for 89.2% of total energy consumption, with natural gas used as the main fuel.

Table 5.2.1: Unit level energy consumption

Category	Thermal energy (toe/year)	Electricity (toe/year)	Total energy consumption (toe/year)
Dyes and pigments	478.2	53.6	531.8
Other chemicals	129	52.8	181.8

5.2.2 Cluster level

The cumulative annual energy consumption of Ahmedabad chemical cluster during 2020-21 is estimated to be 1,44,624 toe (Table 5.2.2).

Table 5.2.2: Cluster level energy consumption

Energy type (Unit)	Unit	Energy consumption	Equivalent toe
Natural gas	(million SCM per year)	121	105,872
Coal	(tons per year)	18,000	8,125
Biomass	(tons per year)	10,800	4,024
Electricity	(million kWh)	308	26,529
Total			**144,624**

Natural gas accounts for maximum share in the total energy consumption (73%) followed by electricity (18%) as shown in figure 5.2.2.

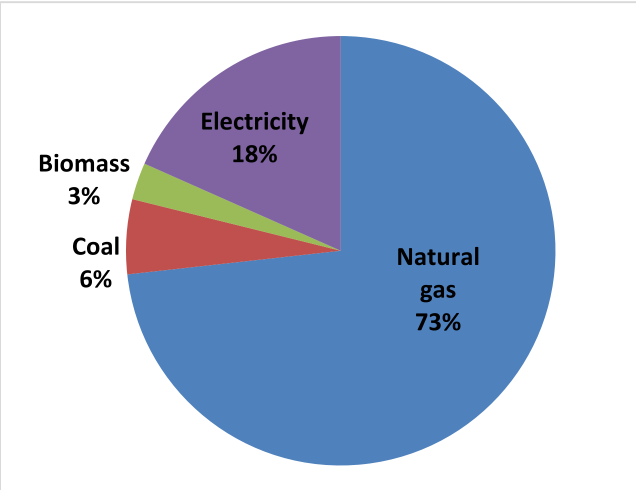

Figure 5.2.2: Share of energy types at cluster level

5.3 Other resources

Apart from thermal energy and electricity, the chemical industries in the Ahmedabad cluster consume other resources such as raw water, treated water and ice blocks in the manufacturing process. Some of the processes used in chemical industries require chilling. A few micro and small scale chemical units in the cluster use ice blocks to meet the cooling requirements instead of ammonia based chiller system. The raw water requirements in the cluster are met through GIDC supply and other private suppliers. The ice blocks are produced and supplied by local ice factories operating in the cluster.

5.4 Energy conservation opportunities

The chemical units in Ahmedabad cluster mostly use locally fabricated technologies, especially for thermal and process equipment. These technologies/equipment are invariable energy in-efficient and polluting. The electrical motors are rewound multiple times that leads to inefficiencies in many of the motor-driven systems. Accordingly, the chemical units in the cluster offer significant scope for energy saving. A list of different energy conservation measures applicable for Ahmedabad chemical units is provided in table 5.4.

Table 5.4: Major energy conservation opportunities in cluster

Equipment/section/utility	Energy conservation measures
Steam system	– Waste heat recovery to preheat boiler feed water – Insulation of boiler feed water tank and pipeline network
Thermic fluid heater	– Optimisation of air-to-fuel ratio and installation of waste heat recovery system
Hot air generator and spray dryer	– Temperature based control system of Spray Dryer (FD Fan, ID Fan, Material Feed Pump) – PLC-based control system for spray dryer operation
Compressed air system	– Installation of VFD for air compressors – Adaption of energy efficient, screw air compressor
Reaction vessels and process	– Installation of the programmable timer for reactor vessels to avoid idle running – Installation of heat exchanger in chilled water circuit – Installation of the programmable timer in Ball mill to avoid idle running
Electric motors	– Replacement of rewound, old inefficient electrical motors with IE3 efficiency class motors
Electrical distribution system	– Automatic power factor correction system – Transformer tap setting change to maintain supply voltage close to 415 – 420 V.
Lighting system	– Replacement of conventional discharge lamp with LED Lamps
Other areas	– Installation of thermostat controller and VFD to automate cooling tower fan operation – Installation of solar rooftop PV system

Chapter 6

6.0 Major challenges in the cluster

The cumulative energy consumption of Ahmedabad chemical cluster is quite significant. The analysis of energy consumption by various sub-processes indicate the use of inefficient technologies and equipment by the cluster units. There exists a significant scope for energy saving in the cluster. However, the cluster needs to address a number of challenges for large scale adoption of energy and resource conservation measures. Some of the major challenges relates to technology, energy pricing, availability and quality of raw material, manpower skill sets, environmental, etc.

The key challenges and their impacts in the cluster are presented in table 6.0.

Table 6.0: Key challenges and their impacts in the cluster

Key challenge	Specific challenge	Impact
Technical	Lack of awareness on efficient technology options MSME is not the priority sector for technology providers Limited knowledge of entrepreneurs and focus on low hanging fruits	• Use of outdated technologies • Higher capital costs for efficient technologies • Longer period for adoption of energy efficient technologies • Reluctance of entrepreneurs on technology upgradation • Apprehension in loss of production
Financial	Higher transaction costs for financing low value loans by banks Mandatory collateral requirements for financing and low credit rating of MSMEs Lack of updation to banks on EE technologies/ equipment	• MSMEs are not able to reap the benefits from technology promotion schemes of banks • Lack of technology adoption on a wide scale among MSMEs • Poor disbursement of loans on EE projects by banks • Low prospects for large scale adoption of new and modern technologies at cluster level
Skillsets	Non-availability of sub-sector specific training institutes at cluster level for skillset improvements Lack of in-house technical capabilities	• Variations in production, productivity, energy performance and quality • Apprehension towards development of new processes and products • Investment by individual units on development of skilled manpower • Lack of in-house innovation on EE projects • Less exposure on new and EE equipment leading to inefficient operation

Key challenge	Specific challenge	Impact
Policies	Non-existence/ availability of sector-specific programs or schemes REFER ANNEXURE-D	• Limited implementation by MSMEs due to high investment required for up gradation of process equipment in targeted sector
Infrastructure & others	Non-availability of cleaner fuels at cluster level e.g. PNG, piped LPG, etc.	• Inefficient use of energy hence high impact on environment • Significant wastage of fuels i.e. PNG use • High risk involved in storing gaseous fuel, uncertain landed cost, interruption in operation
	Fragmented and geographically dispersed nature of units	• Difficulties in accessing common infrastructure facilities e.g. cleaner fuels (piped natural gas), common facility centers, etc.

Chapter 7

7.0 SWOT Analysis

The chemical industries in Ahmedabad face a number of challenges pertaining to regulations on production capacities and exports that can affect the adoption of energy efficiency measures by the cluster units. Over the past five years, there has not been any capacity expansion in the chemical units of the cluster. The MSME units also face challenges due to the increasing cost of energy and raw materials, resulting in increased level of imports in the domestic market. Ahmedabad chemical cluster has many regional advantages that help the cluster remain at the forefront of the Indian chemical industry. There is a need for the chemical units to become efficient and maintain a better profit margin which would require adoption of energy efficient technologies in their processes and auxiliaries. A SWOT (Strength, Weakness, Opportunities, and Threats) analysis of the chemical manufacturing units in the Ahmedabad cluster was performed to understand the cluster situation. The SWOT analysis of the Ahmedabad chemical cluster is given below.

Strength	Weaknesses
• Large number of self-reliant & independent chemical units in Ahmedabad • Active industry associations • Adequate supply of electricity. • Locally available raw materials • Locally available technology suppliers and fabricators • Common effluent treatment plant • Entrepreneurship zeal in local community	• Polluting nature of chemical industries leading to closure of several units • Escalating raw material prices • Use of conventional technologies leading to inefficient production processes • Short product life cycle
Opportunities	**Threats**
• High energy cost for individual unit • Significant potential for energy saving • Potential for expansion and automation of processes • Strong domestic and international market • High scope for expansion in the cluster	• Competition due to low cost imported products/material • Soaring prices of energy sources • Shortage of manpower • Recent entry of substitute products in the market

Chapter 8

8.0 Conclusions

Ahmedabad chemical cluster with more than 750 units is an important industry cluster under MSME sector in the country. The chemical units, producing dyes, dye intermediates, and other chemicals use both thermal energy and electricity to meet their energy demands. The analysis of Ahmedabad chemical cluster shows that thermal energy account for a major share of energy consumption. The energy intensities of these units are also quite high as compared to large units, which may be attributed to the use of inefficient technologies and equipment in both process and utilities. This also results in increased energy costs. Further, limitations such as restrictions on capacity expansions, and environmental related issues have led to the availability of alternate import products and has reduced the market space for local industries.

Optimum use of energy and resource conservation emerge as appropriate solutions for Ahmedabad chemical cluster to achieve competitive manufacturing costs through adoption of new and energy efficient (EE) technologies in processes and utilities. However, to ensure large scale adoption, the cluster has to address a number of barriers which includes non-availability of energy efficient technologies, weak linkages with EE technology suppliers, lack of manpower and skillsets, etc.

The technical assistance with the support of the project would help the chemical industries in Ahmedabad cluster to (i) identify potential process/ utility areas for energy saving, appropriate EE technologies, energy saving potential through detailed energy audits of cluster units (ii) adopt EE technologies through increased awareness and by strengthening linkages with EE technology providers.

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