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Cluster Profile Report

Karnal Chemical Cluster

Prepared for

Bureau of Energy Efficiency (BEE)
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List of abbreviations

AHU	Air Handling Unit
API	Active Pharmaceutical Ingredient
BEE	Bureau of Energy Efficiency
CETP	Common Effluent Treatment Plants
CFC	Common Facility Centre
DET	The Directorate of Employment and Training
DG	Diesel Generator
DIC	District Industries Centre
EC	Electronically Commutated
EE	Energy Efficiency
ETP	Effluent Treatment Plant
FO	Furnace Oil
GHG	Green House Gas
GVA	Gross Value Added
HCCI	Haryana Chamber of Commerce & Industries
HSD	High Speed Diesel
HT	High Tension
HVAC	Heating, Ventilaltion, and Air Conditioning
IBR	Indian Boiler Regulations
ITI	Industrial Training Institutes
kL	Kilo Liter
KPI	Key Performance Indicator
LDO	Light Diesel Oil
LED	Light-Emitting Diode
LT	Low Tension
MSME	Micro Small Medium Enterpreneur
NG	Natural Gas
PCA	Paint & Chemical Association
PLC	Programmable Logic Controller
PV	Photovoltaic
R&D	Research and Development
SLES	Sodium lauryl ether sulfate
SWOT	Strength Weakness Opportunity Threats
TERI	The Energy and Resources Institute
TFH	Thermic Fluid Heater
TOE	Tonne of Oil Equivalent
TPH	Tonne Per Hour
UHBVN	Uttar Haryana Bijli Vitran Nigam
VRV	Variable Refrigerant Volume

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 Haryana Chamber of Commerce & Industries (HCCI) , Paint & Chemical Association (PCA) Karnal 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. Sanjeev Chawla, Director(MSME-DI), Mr R.L. Sharma,Chairman(HCCI) and Mr. Kamaljeet Khanna, President(PCA).

Last, but not the least, interactions and deliberations with MSME-DI, Karnal, 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).

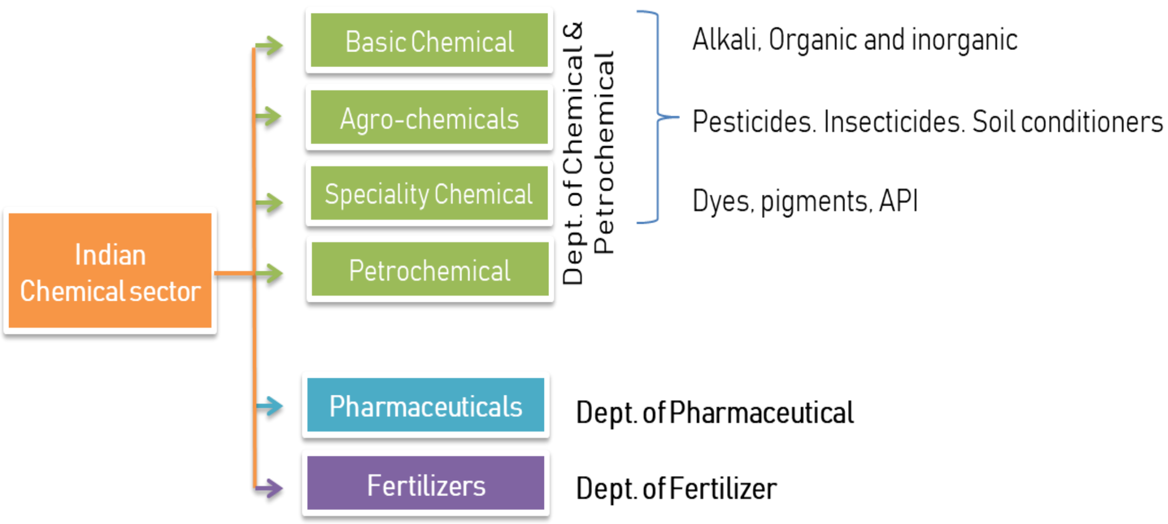

Figure 2.1: Classification of Indian chemical clusters

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 Karnal Chemical cluster

Karnal chemical cluster is one of the important chemical clusters in Haryana. The cluster houses a mix of large scale and MSME units, manufacturing various types of chemical products. There are about 107 chemical manufacturing units in Karnal cluster among which 91 units are operational. All these chemical manufacturing units are located in Karnal & nearby cities & industrial areas.

Some of the leading large scale industries and multinational companies like Goyla Petrochemicals Pvt. Ltd., Vasphar Pharmacetuicals Pvt. Ltd., Coromandal organic and Chemicals ,Vishal Chemicals Company, Supermax Industries Ltd, Super Chemicals, etc. are also located in Karnal. The cluster produces API/pharmaceuticals and specialty in other chemicals such as tablet, capsule, syrup, ayurvedic medicine, surfactants, soaps, detergents, sanitizers, intermediate paints, resins.

2.2.1 Classification of Chemical units

The chemical units in Karnal cluster can be classified either on the basis of the type of products or production capacities. The pharma related product manufacturing units are about 53% of the total number of unit in Karnal cluster. The other chemical manufacturing units such as paints and resins, soaps and detergents, etc. are about 43% of units (figure 2). Though the number of pharma related product manufacturing units are higher, they only produce 10 to 15% of the total production in the cluster (figure 2.2.1).

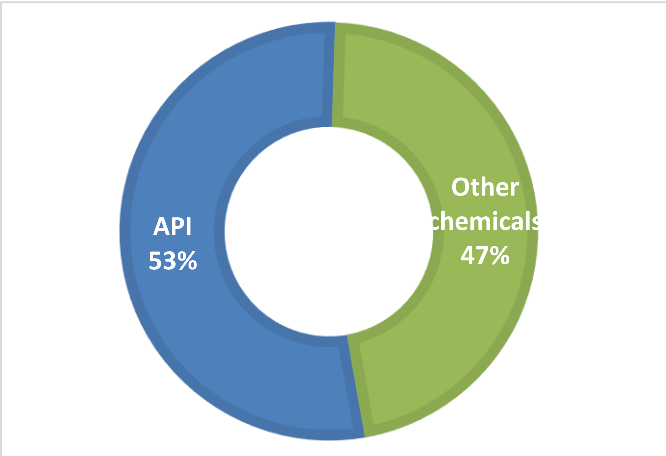

Figure 2.2.1: Unit based classification of Karnal cluster

2.2.2 Major products

The Karnal chemical cluster comprises 107 MSME units of which about 91 are in operation. The cluster produces API/pharmaceuticals and specialty (13%) & other chemicals (87%) such as tablet, capsule, syrup, ayurvedic medicine, surfactants, soaps, detergents, sanitizers, intermediate paints, resins as shown in figure 2.2.2.

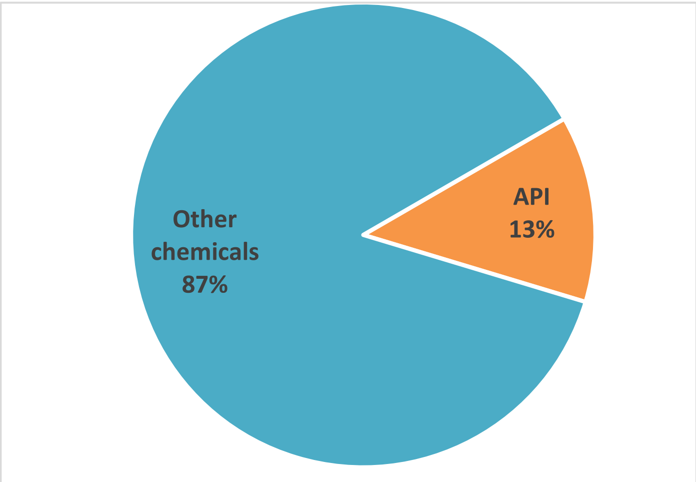

Figure 2.2.2: Production based classification of Karnal

The total production of the cluster is estimated to be 104,528 tonne per year. An estimation of annual production of different categories for the entire Karnal cluster are depicted in **Error! Reference source not ound.**2.2.2.

Table 2.2.2: Chemical products manufactured in Karnal cluster

Category	Production (TPY)
API/Pharmaceutical	13,578
Others chemicals	90,949

2.2.3 Market scenario

The chemical units of Karnal supply their products in domestic markets. As the cluster is producing many type of product in which pharma sector is a major consumer of pharmaceuticals stuffs. Most of the micro units located in Karnal cluster sell their product to agro-chemical industries located near by Karnal District and near by state with pharma industries.

2.2.4 Raw materials

A variety of basic chemicals are used as raw materials to manufacture major chemical products. These basic chemicals are of different types 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).

Raw materials used by chemical units under API/pharmaceuticals category are acids (sulphuric acid, nitric acid, acetic acid, formic acid, phosphoric acid), ayurvedic powder, herbal ingredients, chlorides (thioyl chloride, sodium chloride), oils (castor oil, sulphonated oils), caustic soda flakes, caustic soda lye, lime etc.

The types of raw material used generally in others chemical (soap, detergent powder,bars, sanitiziers, paint & resins) manufacturing units are sodium silicate, caustic soda, china clay, dolomite, non-edible oil, fragrance, softener, resins, liquid solutions, polypropylene glycol, melic anhydride and styrene monomer, soda ash, dolomite, calcite, fragrance, sodium salt, sodium tripolyphosphate, sodium lauryl ether sulfate (sles), sodium carbonate, sodium silicate, dyes etc.

2.2.5 Cluster level initiatives

The programmes and initiatives undertaken by various organisations are listed in the table 2.2.5.

Table 2.2.5: Chemical level initiatives

Organisation	Programme/initiatives	Brief description	Status
Haryana Chamber of Commerce & Industries (HCCI)	Conducting various educational programs and seminars on industrial safety and health	The Haryana Chamber of Commerce & Industry is establlshed with limited liability and is regulated according to the provision of the constitution.	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 Karnal chemical industry cluster along with their roles and activities are briefed below.

3.1 Industries associations

Karnal chemical cluster has many active industry associations and their contact details are given in table 3.1.

Table 3.1: Contact details of industries associations

Name of organisation	Contact details
Haryana Chamber of Commerce & Industry	Address: HSIIDC, Karnal Website: www.hcci.in Contact person: Mr R.L Sharma
Karnal Paints & Chemicals Association	Address: Plot No 252, HSIIDC, Sector-3, Karnal Email: kpmakarnal@gmail.com Contact person: Mr Kamaljeet Khanna
Common Facility Centre Pharma Cluster Pvt. Ltd.	Address: Plot No 361, Sector-3, HSIIDC, Karnal - 132001 Email: cfcpharma2019@gmail.com Website: www.cfctestinglab.com Contact person: Mr Pulkit Kaushik

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: Goverment bodies and key responsibilities

Name of organisation	Key roles
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.
HAREDA	• HAREDA (Haryana Renewable Energy Development Agency) is the state nodal agency (SNA) for the Ministry of New and Renewable Energy Sources (MNRE) and the state designated agency (SDA) for Bureau of Energy Efficiency (BEE). HAREDA has the responsibilities of promoting and implementing the initiatives on renewable energy and energy efficiency in Haryana.

3.3 Technical, academic, and R&D institutions

Both public and private testing laboratories are available in Karnal. Some of the major engineering and polytechnic institutes like Institute of Technology, Karnal Institute, and Naraini group of 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 Karnal 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 20 nationalized, commercial, cooperative banks and branches operating in the cluster.The Bank detail and address are shown in table 3.4. 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: Bank detail of Karnal cluster

Sr. No	Bank Name	Bank Address
1	ABN-Amro Bank	Sector-8, Main Market
2	Allahabad Bank	Sector-6, Main Market
3	Axis Bank	Near Police line, Mall Road
4	Bandhan Bank	Sector-12, Main Market
5	Bank of India	Main Road, Kunjpura Road
6	Canara Bank	Opp. Web World, Kunjpura Road
7	Central Bank	Sector-13, Main Market, near Kalra Sweets
8	DCB Bank	Mugal Canal Market
9	HDFC Bank	Sector-8, Main Market
10	ICICI Bank	Sector-13, Main Market,oppsite Vidya Mandir
11	IDBI Bank	Sector-12, Main Market
12	Indusind Bank	Sector-12, Main Market
13	Nanital Bank	Behind Guru harkrishan public school,Mugal Canal market
14	Punjab National Bank	Sector-7, Main Market
15	Syndicate Bank	Meera Gati, GT Road
17	State Bank of India	Main branch,Opp. Govt. girls sr. sec. school
18	The Karnal co-operative Bank	R.K Puram
19	The Karnal urban Co-operative Bank	Ram Nagar
20	Vijaya Bank	Sector-12, Main Market

Chapter 4

4.0 Production process and technology use

The chemical manufacturing process varies with the products and production capacities. The industries use reactor vessel or mixing tank to facilitate chemical reaction by heating /cooling as needed. On completion of chemical reaction, mother liquor is passed through next step of operation to produce cake or paste, which is subsequently dried, seized, etc. before packaging of final products completed. However, the manufacturing process and technologies/ equipment used for primary chemical products such as (1) API and pharma intermediate and (2) Other chemicals industries in the MSME sector are discussed in this section.

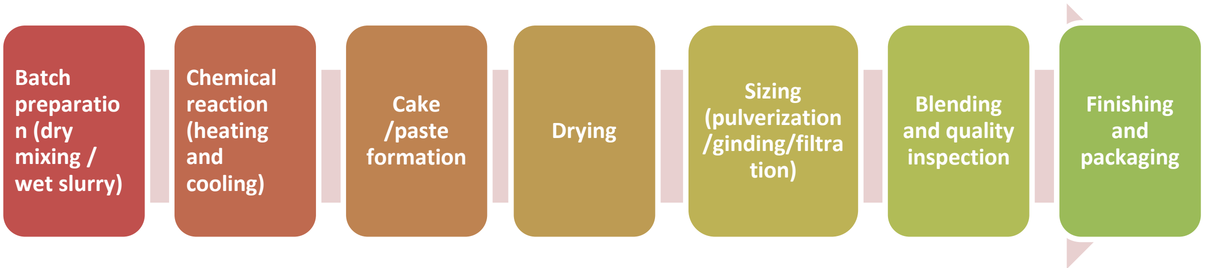

Figure 4.0: Process steps of chemicals manufacturing

4.1 Manufacturing process for Paint Industries

The paint manufacturing process adopted in the plant includes batch preparation from a proportional mixture of color pigments, solvents, binders, and resins. The process begins by mixing these selected raw materials in a mixing tank. The grinding media is placed in the mixing tank to break down the coagulation of raw materials while the drum is being rolled using the electric motor. The batch period of the mixing process is in the range of 7-10 hours to attain adequate homogeneity. After mixing, a test is to be carried out to check the quality of the produced such as viscosity and passed solution unloaded in the stationary tank. In the quality passed produced, additives compounds are added to impart proper drying quality to the paint when applied on a surface and the drying time is checked for conformity.

The final product is further sieved through a micron filter to remove uneven sizes and to maintain the desired fineness. The basic process steps of paint manufacturing are given in Figure4.1.

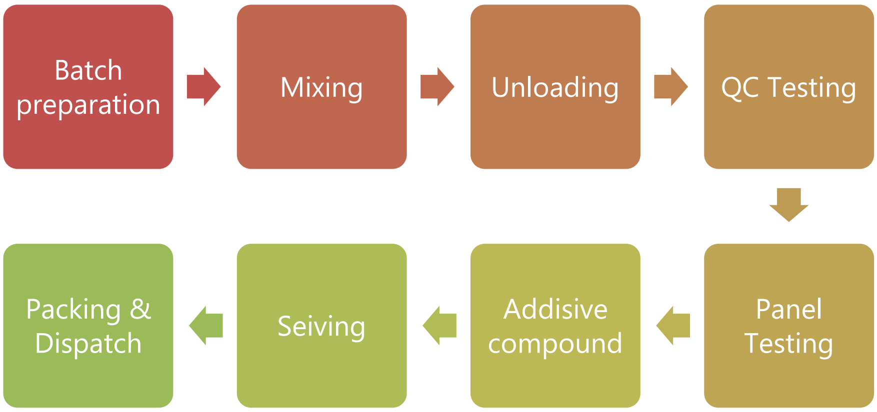

Figure 4.1: Production process of paint manufacturing

4.2 Manufacturing process for Soap Bars

A Soap, by definition, is the sodium or potassium salt of a long-chain fatty acid. Hence, the prime raw materials required for manufacturing a soap constitute sodium silicate, caustic soda and non-edible oil along with filler materials like China clay, dolomite, softener and desired fragrance. All these raw materials are thoroughly mixed in proportionate content in a crusher at a temperature of 70 – 80 °C. Under this process, the mixture turns into a semi-solid state at which point special ingredients like coconut oil or almond oil are added to the mixture. The entire crushing and mixing process continues for about 4 hours for a 5 tonne batch. Then this semi-solid/ paste mixture is poured into a set of trays and allowed to cool down and soak. This soaking process is carried out in a well-ventilated area under several wall-mounted fans to facilitate quicker cooling. Soaking helps in removing moisture from the soap so that it does not break at the time of stamping and pressing. After soaking, soaps are forwarded to stamping machine to give proper looks and shape to the soap. Thereafter the soap is cut into desired sizes and then finally sent for packaging.

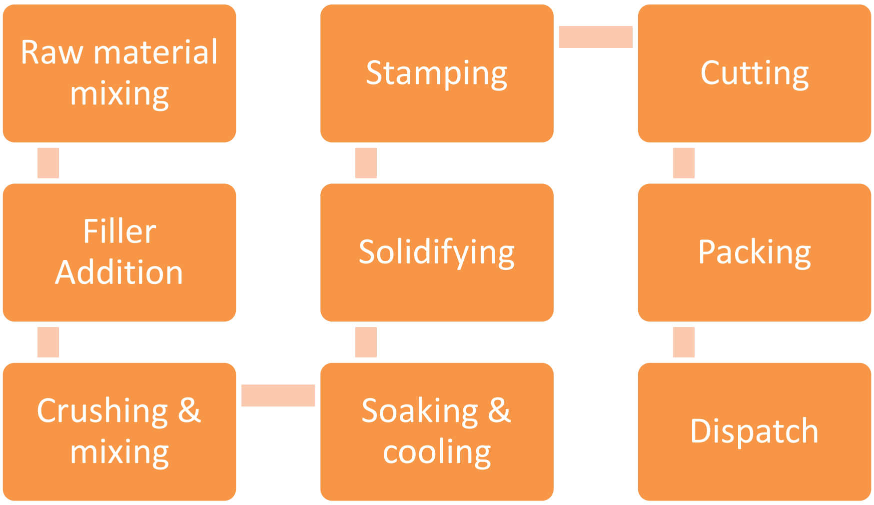

Figure 4.2: Production process of Soap bars manufaturing

4.3 Manufacturing process for Detergent Powder

The manufacturing of detergent, both bars & powder, is primarily based on proportionate mixture of certain chemical compounds and additives in the right proportions. The process begins by thorough mixing of the raw materials like soda ash, dolomite, calcite, fragrance, sodium salt, sodium tripolyphosphate, sodium lauryl ether sulfate (sles) in the right proportions in a horizontal drum-type mixer. In case of detergent bar, the mixing process is followed by loading into an extruder whereby the mixture undergoes hot extrusion process and comes out in the shape of bars which is then cut into definite sizes and forwarded for packaging.

The detergent powder processing requires the mixture to be sieved through a vibratory screen to separate out the chunks and/ or foreign particles and then filled into desired packet/ pouches through a filling machine and then packed for dispatch. The basic process steps of detergent bar and detergent powder are given in Figure 4.3.

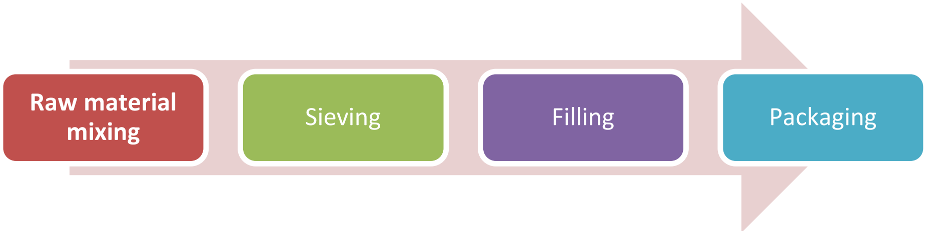

Figure 4.3: Production process of Detergent manufacturing

4.4 Manufacturing process for Pharmaceuticals

The raw materials for the tablets and capsules are procured in the form of chemical powders and/ or salts. These powders are tested and segregated in weighed proportions as per the desired composition of the tablets / capsules. This weighed mixture is then mixed to form a starch paste and then checked for desired quality. Once the specified composition is achieved, the starch paste is set to dry in an electric dryer. The dried mixture then undergoes sieving process to remove uneven chunks from the batch and form the desired sized capsules/ tablets. These raw tablets then undergo lubrication process to prevent sticking to one another. Further these tablets are sent for film coating to prevent being affected by atmospheric moisture. These coated tablets/ capsules are then once again passed through quality check for medical standards and composition before being forwarded for packaging. The final product is then packed by packaging machines and then dispatched. The basic process steps of tablet/ capsule manufacturing are given in Figure 4.44.4.

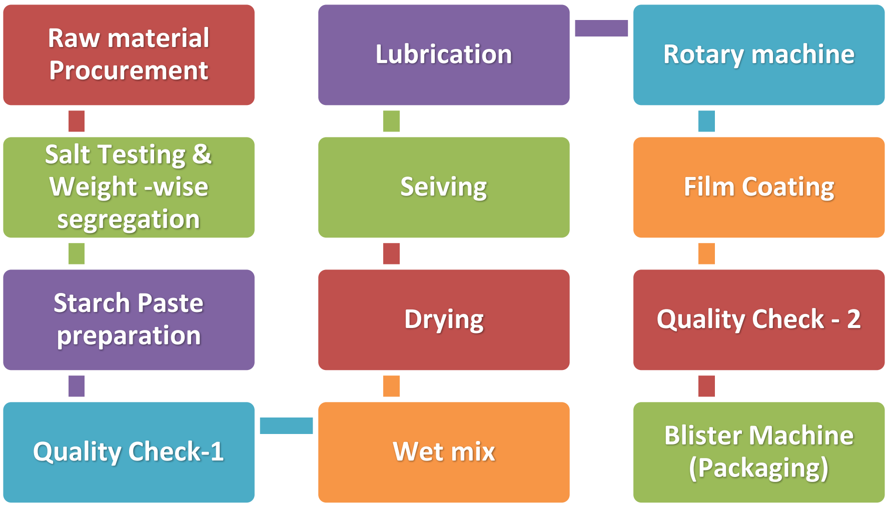

Figure 4.4: Prodction process of Pharmaceuticals manufacturing

4.5 Major technologies and equipment

A variety of chemical products like dyes, pigments, paints, agro-chemicals, and pharmaceutical products are manufactured in Karnal 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 4.5.

Table 4.5: Major technolgies/equipment used in chemical industries

Manufacturing process	▪ Mixer drum ▪ Reaction vessels/kattles ▪ Centrifuge ▪ Dryers
Auxiliaries/utilities	▪ Steam boilers ▪ Pumps ▪ Blowers/Fans ▪ Air compressors ▪ Thermic fluid heaters ▪ Cooling towers ▪ Air Conditioning Units ▪ DG Sets

4.5.1 Details of process equipment

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

4.5.1.1 Mixer Drum

The mixer drum carries grinding stones inside, which help to break down the coagulation of raw materials while the drum is being rolled/ rotated for mixing. The mixing process is an exothermic reaction and is carried out for 7 to 10 hours to attain adequate homogeneity. The chemical units have different capacities of mixer drum varying in the range of 100-400 litre . The capacities and number of vessels in a chemical unit are dependent on type of manufacturing process, production capacity and batch size.

4.5.1.2 Reaction Vessels/kattles

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. The capacities and number of vessels in a chemical unit are dependent on type of manufacturing process, production capacity and batch size.

4.5.1.3 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.

4.5.1.4 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 is used namely tray dryer, fluidized bed dryer, rotary vacuum dryer, and spin flash dryer. Steam boilers, thermic fluid heaters, and hot air generators are used for providing heating requirements in the dryer.

4.5.2 Details of auxiliaries equipment

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

4.5.2.1 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 coal is the major fuel used in boilers to generate the steam.. 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.

4.5.2.2 Pumps

The pumps are one of the major energy consuming equipment in chemical industries and the pumps are installed for boiler feed water pumps, process circulation pumps and plant water supply pumps. Majority of the pumps installed are of local make or old and pumps are found to be highly inefficient.

4.5.2.3 Blowers/Fans

The bowers or fan are used for different purposes in the chemical units like exhaust blower, FD fan ID fan etc. The capacity of blowers varies according to its purpose of use and capacity of the system.

4.5.2.4 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.

4.5.2.5 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..

4.5.2.6 Cooling towers

Cooling towers are used to cool down hot water coming from process, boilers, chillers etc. It is a heat rejection equipment where the heat from water rejected to atmosphere by means of evaporation process. A cooling tower normally includes a fan for air supply to increase the evaporation rate and a pump for water circulation from process to the cooling tower inlet.

4.5.2.7 Air Conditioning Units

Some of the chemical units manufacturing API/Pharmaceuticals require to maintain the inhouse temperature. To meet this process cooling requirements, air conditioners are mainly used in these units.

4.5.2.8 DG Sets

DG sets are being used as backup power generator and operates only when power failure occurs. HSD is the common fuel for the DG sets. For power backup, 63 to 125 kVA DG sets are installed in majority of the units.

Chapter 5

5.0 Energy consumption profile and conservation measures

5.1 Details of energy use

The chemical industries in Karnal 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 Karnal cluster. The levels of energy consumption in these units are dependent on the type of products and the process followed. Types of energy sources used in the cluster mainly include coal, firewood and electricity, HSD is used for backup power generation.

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
Coal	Local market	4,200-4,800 kCal/kg	Rs 6-8 /kg
Firewood	Local market	3726 kCal/kg	Rs 3-4 /kg
FO/LSHS/LDO	Local distributor	8832 Kcal/kg	Rs. 51.12/Liter
HSD	Retail outlets	10,580 kCal/kg	Rs.77 /Liter

5.1.2 Electricity

Electricity is used in electric motors to operate utilities such as agitator systems of reaction vessels, centrifuge, 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 Haryana Bijli Vitran Nigam (UHBVN). The applicable tariff of various such categories is given in 5.1.2.

Table 5.1.2: Electricity tariff plans in Karnal chemical cluster

Category	Tariff Category	Demand Charges	Energy Charges
LTIS	Upto 10 KW	Nil	Rs 635 Pasie per kVAh
	10 KW to 20 KW	Nil	Rs 665 Paise per kVAh
	20 KW to 50 KW	Rs 160 per kW per month	Rs 640 Paise per kVAh
HTS	Upto 500 kVA of billing demand	Rs 165 per kVA per month	Rs 665 Paise per kVAh

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 Karnal chemical industries are summarised below.

5.2.1 Unit level

The "API/ pharmaceutical" category units in Karnal chemical cluster consumes only electrical energy. The energy consumption range varies from 4.4 to 8.4 tonnes of oil equivalent (toe) per year Table 5.2.15.2.1a.

Table 5.2.1: Unit level energy consumption in API/Pharmaceutical

Category	Thermal energy (toe/year)	Electricity (toe/year)	Total energy consumption (toe/year)
API/Pharmaceutical	-	6.82	6.82

The typical "other chemical" category units in Karnal chemical cluster consumes both thermal and electrical energy. The electrical energy consumption range varies from 0.7 to 44.5 tonnes of oil equivalent (toe) per year and thermal energy consumption range varies from 132 to 474 tonnes of oil equivalent (toe) per year as shown in Table 5.2.1b. Thermal energy accounts for 88 % of total energy consumption, with Coal & HSD is used as the main fuel.

Table 5.2.1b: Unit level energy consumption Other Chemical

Category	Thermal energy (toe/year)	Electricity (toe/year)	Total energy consumption (toe/year)
Others chemicals	101.15	13.77	114.92

Here it is to be noted that the bandwitdths of annual energy consumption are very wide for units producing other chemicals. Such wide bandwidths are caused by the following factors:

a. Wide variation in production and capacity of the units
b. Variation of energy intensity of products manufactured under same category
c. Technology/equipment used for production
d. Variation in ratio of electrical and thermal energy consumption

Moreover, the average thermal energy as well as the total energy consumption for the units manufacturing other chemicals are less than the lower limit as thermal energy is being used in one third number of such units.

5.2.2 Cluster level

The chemical industries in Karnal cluster uses LDO and coal to meet energy requirements in the process along with grid electricity. HSD is used for backup power generation. The total energy consumption of the cluster is estimated to be 4,947 toe. Thermal energy accounts for 82% and electrical energy 18% of total energy consumption (Figure 5.2.2). Coal accounts for about 64% of total energy consumption followed by LDO (21%) in the cluster (Figure 5.2.2). The total GHG emissions of the cluster is estimated to be 22,832 tonne CO2 per year. The cluster level energy consumption and GHG emissions are shown in table 11. About 56% of GHG emissions are attributed to use of coal.

Table 5.2.2: Cluster level energy consumption

Energy Source	Unit	Annual consumption	Equivalent energy consumption (toe/year)	GHG emissions (t CO2/yr)
Coal	tonne/year	7007	3163	12724
LDO/FO/HSD	KL/year	1171	1033	3209
Electricity	MU kWh/year	8.7	751	6899
Total			**4947**	**22832**

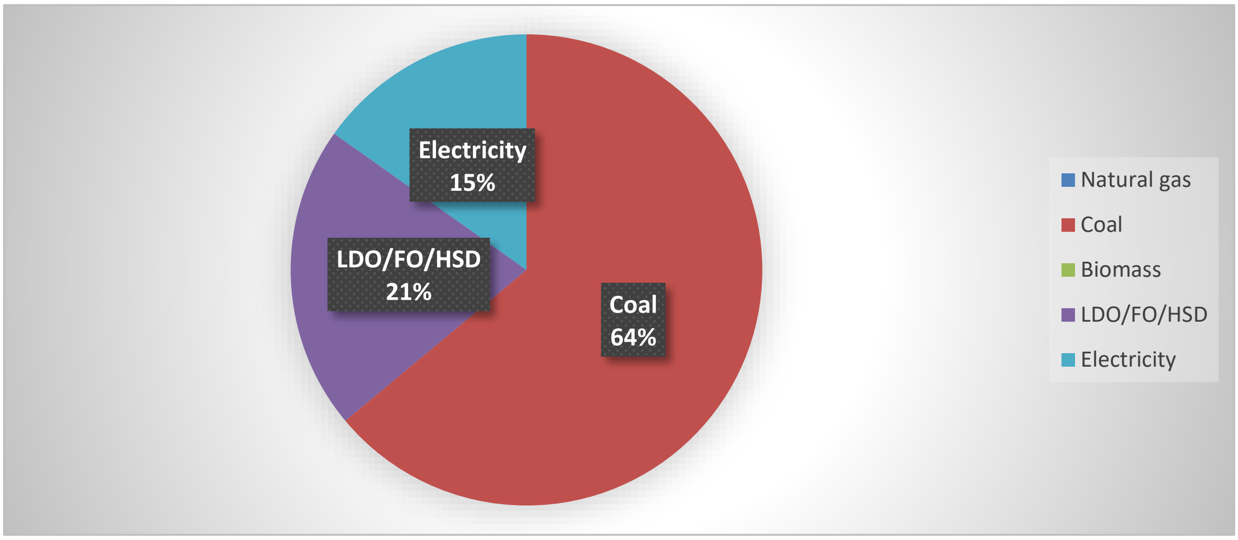

Figure 5.2.2: Cluster level energy consumption

5.3 Other resources

Apart from thermal energy and electricity, the chemical industries in the Karnal cluster consume other resources such as raw water and treated water in the manufacturing process.

5.4 Energy conservation opportunities

The chemical units in Karnal 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 Karnal chemical units is provided in table 5.4.

Table 5.4: Major energy conservation opportunities in cluster

Equipment/section/utility	Energy conservation measures
Compressed air system	– Adaption of energy efficient, screw air compressor
Steam system	– Condensate recovery – Reduction of dry flue gas losses – Waste heat recovery – Reduction of surface heat losses by using proper insulation

Equipment/section/utility	Energy conservation measures
Thermic fluid heater (TFH)	– Maintaining air fuel ratio – Reduction of dry flue gas losses – Waste heat recovery – Reduction of surface heat losses by using proper insulation
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
HVAC	– Retrofit & replacement in AHU units with EC Fans & VRV System
Renewable Energy	– Install Solar roof top PV system

Chapter 6

6.0 Major challenges in the cluster

The cumulative energy consumption of Karnal 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. The key challenges in chemical industries operating in MSME sector can be broadly grouped into technical, financial, skillsets, policy related and infrastructure. The specific challenges and impacts are depicted in6.0.

Table6.0: Key challenges in chemical sector

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
Policies	Non-existence/ availability of sector- specific programs or schemes	• Limited implementation by MSMEs due to high investment required for up gradation of process equipment in targeted sector

Key challenge	Specific challenge	Impact
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 Karnal 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. Karnal 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 Karnal cluster was performed to understand the cluster situation. The SWOT analysis of the Karnal chemical cluster is given below.

Table 7.0: SWOT Analysis

Strength	Weaknesses
• Large number of self-reliant & independent chemical units in Karnal • Active industry associations • Adequate supply of energy sources like coal, oil, electricity, etc. • Locally available raw materials • Locally available technology suppliers and fabricators • Entrepreneurship zeal in local community	• Polluting nature of chemical industries leading to closure of several units • Limited scope for expansion in the cluster • Acute shortage of skilled manpower • 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 automation of processes • Inclusion in the industrial corridor zone • Product customization and demand for new and alternative products • Huge domestic and international market	• Competition due to low cost imported products/material • Soaring prices of energy resources • Shortage of manpower • Recent entry of substitute products in the market • Escalating raw material prices

Chapter 8

8.0 Conclusions

Karnal chemical cluster with more than 107 units (91 operational) is an important industry cluster under MSME sector in the country. The chemical units, producing API/pharmaceuticals and other chemicals, use both thermal energy and electricity to meet their energy demands. The analysis of Karnal 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 Karnal 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, clean fuel (PNG), 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 Karnal 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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