CHAPTER ONE

1.0 ABOUT BEE'S SME PROGRAM

1.1 Project Objectives

The Bureau of Energy Efficiency (BEE), set up under the Energy Conservation Act, 2001, is entrusted with the responsibility of reducing the energy intensity in Indian economy. An important area of BEE's work is the small scale sector, known more popularly as the Small & Medium Enterprise (SME) sector. A scheme called the BEE SME Programme has been designed for improving the energy efficiency in SMEs.

The global objective of the project is to improve the energy intensity of the Indian economy by undertaking actions in the SME sector which directly or indirectly produced 60% of the GDP.

The immediate objective of the project is to accelerate the adoption of EE technologies and practices in 29 chosen clusters in the SME sector through knowledge sharing, capacity building and development of innovative financing mechanisms.

The specific objective of the scheme is to improve the energy intensity of the Indian economy by undertaking actions in the SME sector and to accelerate the adoption of energy efficient technologies and practices in the identified clusters in the SME sector through knowledge sharing, capacity building and development of innovative financing mechanisms.

1.2 Expected project outcome

- BEE has initiated diagnostic studies in 29 SME clusters to collect information on energy consumption practices, technology status, best operating practices, gaps in skills and knowledge, energy conservation opportunities, energy saving potential, etc. A cluster specific energy efficiency manual in each cluster including above will also be prepared.
- BEE will also undertake capacity building of local service providers and entrepreneurs / managers of SMEs.
- The scheme will churn out bankable detailed project reports (DPRs) for about 435 energy efficiency projects in the 29 clusters.

- BEE-SME scheme has also been linked to the Ministry of Micro Small and Medium Enterprises (MSME) programme for SMEs for capitalization of DPRs prepared under this scheme and provision of subsidy for EE technologies / measures.
- Identification of energy efficient technologies for the clusters.
- Capacity building programme for industry owners, industry association & local service providers, bankers, etc.
- Likely improvement in product quality through better technology.
- Development of innovative financing mechanism under the scheme will give the industry owners an opportunity to avail loans at low rate of interest and risk cover from the Financial Institutions.
- The Bankable DPRs will speed up the disbursement of loans through local bankers.
- Leverage of Clean Development Mechanism (CDM) projects at cluster level that involves a change in the process and technologies as a whole.
- SMEs will be able to reduce their cost of production because of improved energy performances due to this scheme.
- All the above will provide competitive edge to SMEs over the international market for the products manufactured in India.

1.3 Project duration

Duration of the project is around two and half years. Situation analysis which was the first activity as part of this programme was started in January 2009. The DPRs would be completed by December 2010. The terminal activity of this project is planned to be completed by July 2011.

1.4 Identified clusters under the program

A total of 28 clusters have been finally identified by BEE in three phases, after a Situation analysis in 35 clusters; and the progamme is being implemented in two phases:

Table 1.1: List of BEE SME Energy Efficiency Programme Clusters

Sl. No.	Phase	Sector Name	Cluster Name	State
1	1	Chemicals	Ahmedabad	Gujrat
2	1	Rice milling	Warangal	Maharashtra
3	1	Brass	Jamnagar	Gujrat
4	1	Textiles	Solapur	Maharashtra
5	1	Textiles	Surat	Gujrat
6	1	Textiles	Pali	Rajasthan
7	1	Ceramics	Morbi	Gujrat
8	2	Oil Mills	Alwar	Rajasthan
9	2	Machine tools	Bangalore	Karnataka
10	2	Foundries	Batala, Jalandhar and Ludiana	Punjab
11	2	Ice making	Bhimavaram	Andhra Pradesh
12	2	Brass	Bhubaneswar	Orissa
13	2	Refractories	E and W Godavari	Andhra Pradesh
14	2	Rice milling	Ganjam	Orissa
15	2	Dairy	Gujarat	Gujarat
16	2	Galvanizing and wire drawing	Howrah	West Bengal
17	2	Brass and Aluminium utensils	Jagadhri	Haryana
18	2	Lime kilns	Jodhpur	Rajasthan
19	2	Tea	Jorhat	Assam
20	2	Sea food processing	Kochi	Kerala
21	2	Paper	Muzaffarnagar	Uttar Pradesh
22	2	Sponge Iron	Orissa	Orissa
23	2	Chemicals	Vapi	Gujarat
24	2	Bricks	Varanasi	Uttar Pradesh
25	2	Rice milling	Vellore	Tamil Nadu
26	3	Coir	Alleppey	Kerala
27	3	Tile	Mangalore	Karnataka
28	3	Textile	Tiripur	Tamil Nadu
29	3	Glass	Firozabad	Uttar Pradesh

BEE has engaged IISWBM as the Executive Agency for the Howrah cluster for the study of galvanizing and wiredrawing sector under the second phase of implementation in the present scheme.

CHAPTER TWO

2.0THE HOWRAH CLUSTER SCENARIO

2.1 Overview of Howrah SME cluster

2.1.1 Galvanizing and Wire-Drawing Industry

Galvanizing process is gaining more importance now a days as the cost of corrosion resistant paints are increasing and the durability of galvanized products are far more than any other corrosion repellants. It is the art of coating any metallic surface prone to atmospheric corrosion, with Zinc. In hot-dip galvanizing method a thin layer (say 100 µ) of zinc is applied on the surface and the coating lasts for more than a decade. Where as the electro-plating of zinc is much thinner and the life is also less. Many of the galvanizing industries are large-scale units.

Indian standard for RECOMMENDED PRACTICE FOR HOT-DIP GALVANIZING OF IRON AND STEEL was first published in 1966 and went through several editions till the reaffirming in 2006 as given in IS: 2629-1985.

The wiredrawing machines are with large number of motors, which are found to be mostly second hand. Copper, aluminium and to the maximum extent MS wires are processed.

The capacity and turnover of both galvanizing and wiredrawing SME units in Howrah cluster are varying with the factor of more than 10. They are mostly traditionally owned and maintained by families who are in such business for several generations. The main advantage of such business is the scalability of process and low initial investment; say even a few lakhs of rupees, required for starting a smaller unit. These units generate significant employment in the locality, though manpower cost is 1-3% of the total manufacturing cost. Energy cost is varying from 1% to 15% of the total production cost, as more than 90% of the total production cost goes to materials purchase in many cases. In some cases the units are engaged in a contract of just provide the service, the cost of zinc, etc. is bourn by the client that may be another galvanizing unit; as a result, the energy cost may soot up as high as 83%, manpower 10% and chemical, etc. 7% of the total cost of production.

2.1.2 Cluster background

Howrah District is one of the 19 districts in West Bengal and known as the smallest district in West Bengal. One part of the district is fully engaged with industrial activities while other part is still going through the agricultural efforts. Howrah lies along the west bank of the Hooghly River directly opposite to Kolkata (erstwhile Calcutta). It is Kolkata's largest satellite city and is the second largest city in West Bengal state. Howrah has major Grand Trunk Road connections and is the eastern terminus of major rail lines traversing eastern, northern, and central India. the city is connected to Kolkata across the Hooghly River by the massive and heavily traveled Howrah (1943) and Hooghly (1987) bridges. Howrah's river port is lined with shipbuilding and repairing docks, and on the riverbank and elsewhere are jute, flour, rice, oilseed, and cotton mills; sawmills; iron and steel rolling mills; and factories making chemicals, glass, hosiery, cigarettes, and batteries, light industry and railway workshops etc. There are numerous galvanizing and wire-drawing units in the SME cluster of Howrah. as per the field survey and information report of BEE (Bureau of Energy Efficiency), DIC (District Industries Centre) and other reliable sources there are about 50 Galvanizing and 51 Wire-drawing units in the entire SME Howrah Cluster which have been identified for energy conservation studies and recommendation tips. Most of the Galvanizing and Wiredrawing units are traditional family business and in operation for long 25-30 years. Majority of the Galvanizing and wiredrawing units generally operate for one shift (varying from 10 hours to 12 hours) a day. But some of the Galvanizing and wiredrawing has bigger production unit operating in two shifts per day. The major machineries employed in a typical Galvanizing unit are Furnaces that are both Oil fired and Coal fired type. in addition to these furnaces there are air-blowers, oil heaters, EOT Cranes that can be classified as auxiliary equipments. for Wire-drawing industries the major machineries include the Wire-drums that are driven by electric motors. The other auxiliary equipments include welding machines, grinding machines, pointer machines, small hp rating pumps etc.

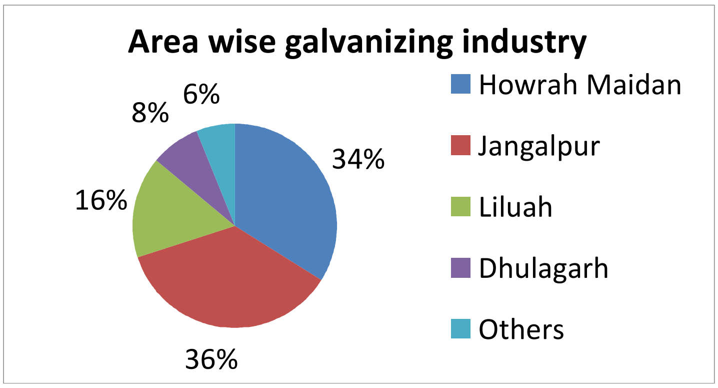

Figure 2.1: Area-wise Classification of Galvanizing Units in Howrah Cluster

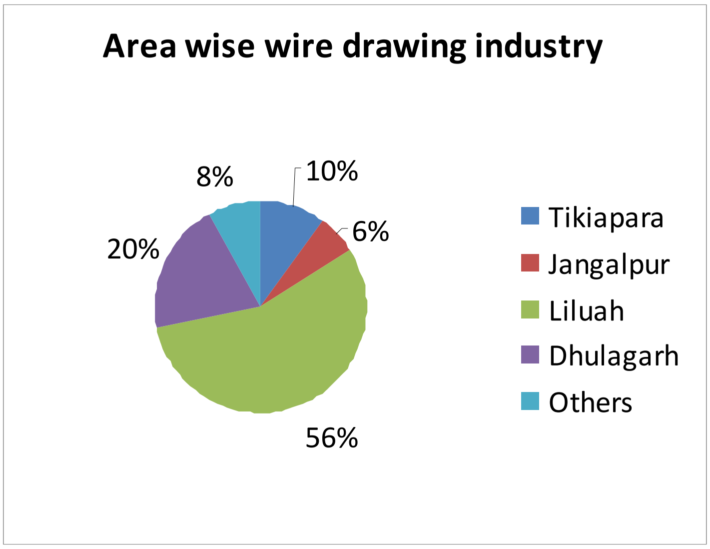

Figure 2.2: Area-wise Classification of Wire-drawing Units in Howrah Cluster

2.1.3 Product manufactured

The galvanizing units are involved in fabrication and galvanizing of the components of the transmission wire structure, different sizes of nails, nuts and bolts, MS wires, and galvanizing of, in fact, any iron components with size varying from a few centimeters to several meters in length and with different shapes from thin wires to round balls.

Products manufactured by wire drawing units are mainly wires of MS / copper / aluminium of varying gauges from 32 (0.2 mm dia.) to 12 (2 mm dia.).

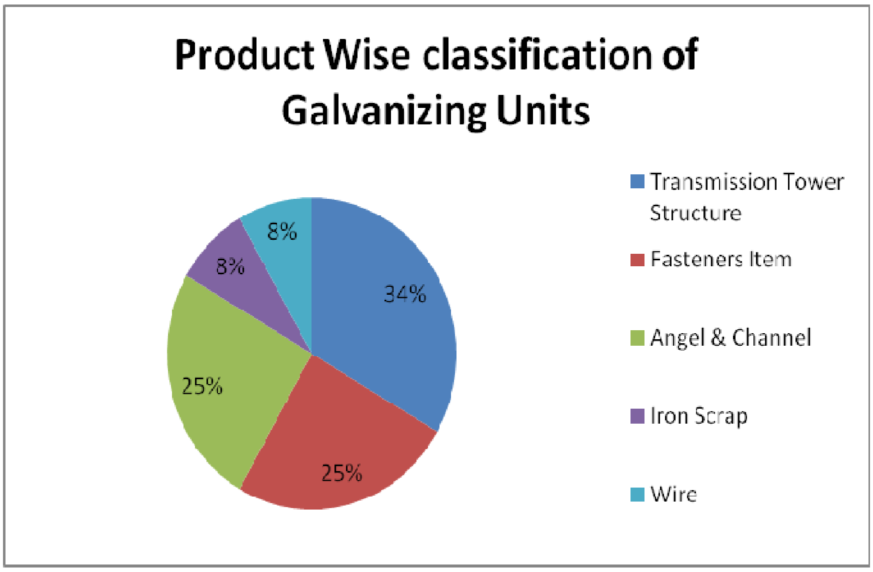

Figure 2.3: Product Wise Classification of Galvanizing Units

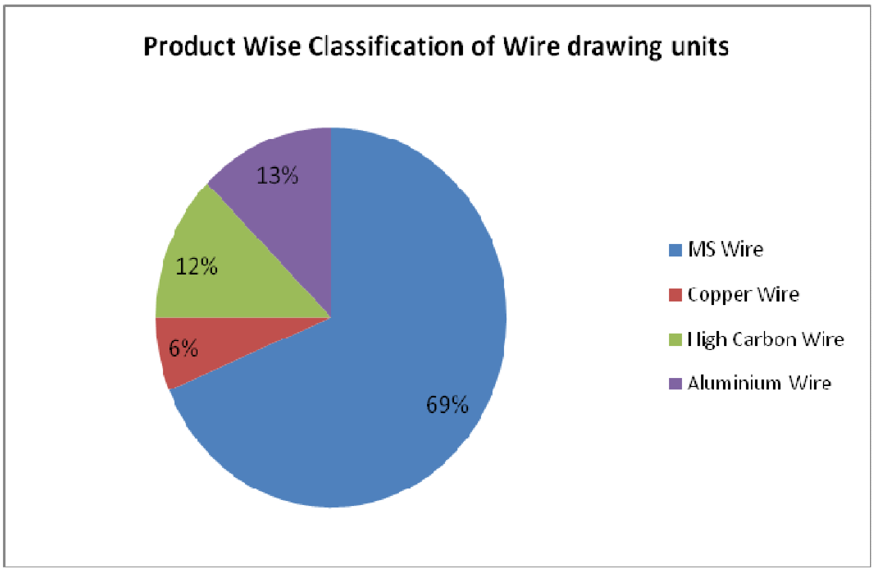

Figure 2.4: Product Wise Classification of Wire-drawing Units

2.1.4 Classification of Units

Classification of Galvanizing & Wire-drawing units, based on size, raw materials used and type of product is given in Table 2.1.

Table 2.1: Classification of Galvanizing and Wire-drawing Units

	Size	Raw Materials	Products	Areas
Galvanizing	100-500 TPA; 501-1000 TPA and above 1000 TPA	• Nuts and Bolts • Components/elements of telephone/mobile towers. • Components/elements of power transmission towers.	• Nuts and Bolts • Components/elements of telephone/mobile towers. • Components/elements of power transmission towers.	• Howrah Maidan • Liluah • Jangalpur • Dhulagarh • Others
Wire-drawing	100-500 TPA; 501-1000 TPA and above 1000 TPA	MS, High Carbon, Al and Cu wires	Thin wires as a tool in electro-chemical discharge manufacturing (EDM) process Wires for day-to-day use Wires for making nails Wires for Transmission and Distribution cables	• Liluah • Jangalpur • Tikiapara • Dhulagarh • Others

2.1.5 Production capacity (in Ton or pieces per year) detail

In both Wiredrawing and Galvanizing units in Howrah, the production capacity has been found to vary more than 10 folds. There are Wire-drawing units producing as low as 241 Ton/year to as high as 3500 Ton/year. Similarly, the production from Galvanizing units has been found to be within the range of 890 to 7500 Ton per annum. The annual production Figures for 15 such units where detailed energy audit have been completed is given in Table A of Annex 1. IS: 2629-1985 gives "RECOMMENDED PRACTICE FOR HOT-DIP GALVANIZING OF IRON AND STEEL" describing the standard operating practice for galvanizing production process but no Specific Energy Consumption norms.

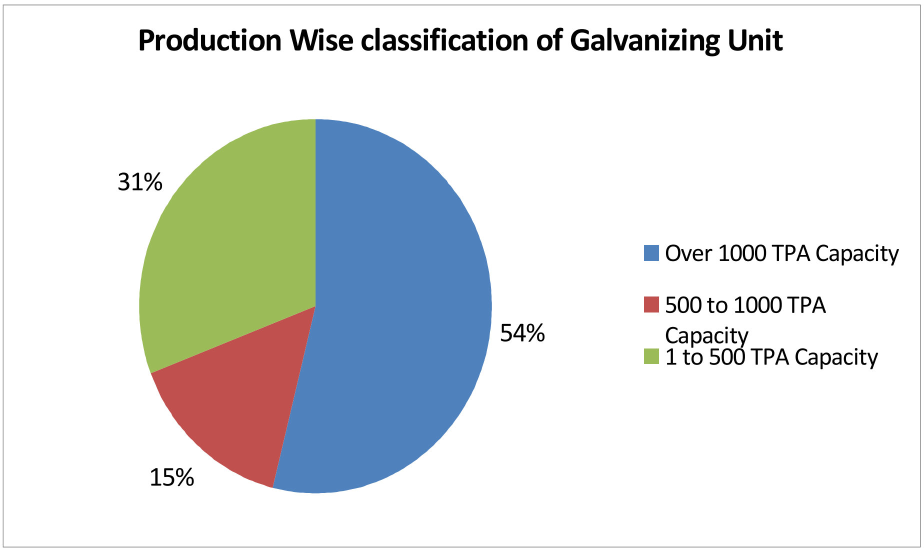

Figure 2.5: Production Wise Classification of Galvanizing Units

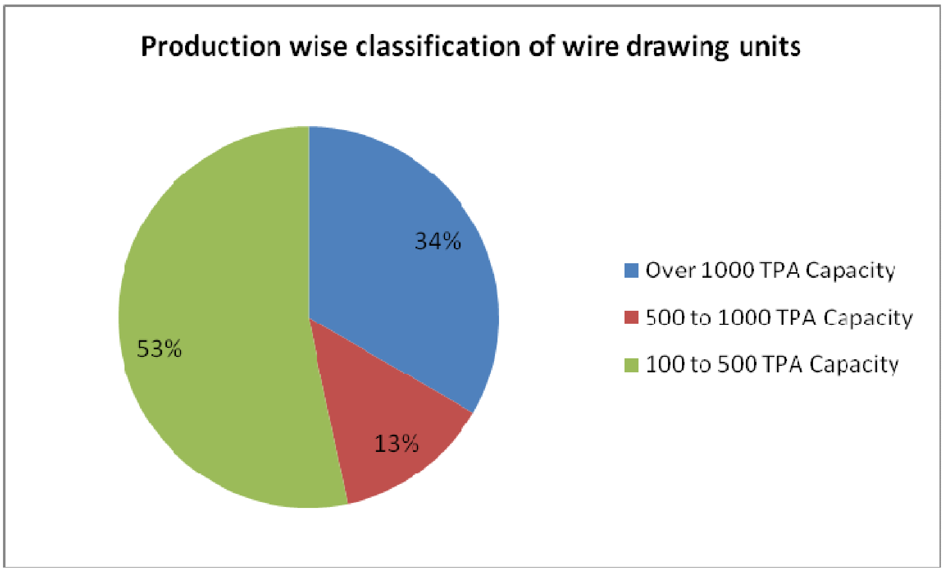

Figure 2.6: Production Wise Classification of Wire-drawing Units

As shown in the figures above, more percentage of the galvanizing units are of higher production capacity than their counterpart in Wire-drawing units, where the majority are in the smaller range i.e. production capacity lower than 100 TPA.

2.1.6 Raw materials used

Zinc, Ammonium Chloride, Hydrochloric Acid, and Di-chromate powder are the major raw materials used in Galvanizing units.

Raw Materials used in Wire-drawing units are MS / Copper / Aluminium Wires of gauges varying from 14 to 4 gauge i.e. 1.6 to 5.1 mm dia., while Uni-Lab powder (of Predington company based in Bombay) or Grommet–44 is used for lubrication (eg.).

It may be noted that the raw materials, item-wise, were same before the galvanizing or wire-drawing process; only the value addition (zinc coating) or reduction in diameter took place. Therefore, the classification would be same as that of the share shown in the pie charts for classification of product type.

2.2 Energy Situation in the Cluster

Energy, raw materials and manpower are the three essential inputs for both Galvanizing and Wire-drawing units. In Galvanizing Units in Howrah cluster, energy cost is about 14 to 30% of the production cost. Energy cost share is lower with compared to total cost as the size of the unit is more or the capacity utilization is more. This is more predominant in Galvanizing Units as all those units have furnace which consumes more energy for part load or if production is stopped in any shift in a day. In a typical Galvanizing Unit in Howrah cluster, energy cost is about 24% as shown in Figure 2.7. Where as in a typical Wire-drawing Unit, it is only 3%, against the average share of energy cost varying from 1% to 14% of total cost. However, energy cost is the most important controllable cost component amongst all in both Galvanizing and Wire-drawing units.

Table 2.2: Fuel and Electricity Details in Galvanizing Howrah Cluster

Galvanizing Units						
Fuel	**Price paid by the Galvanizing Units**			**Unit**	**GCV* or Conversion**	
	Min	**Max**	**Average**		**Average**	**Unit**
Electricity	4.59	9	5.79	₹/kWh	860	kcal/kWh
Coal	4.7	7	5.93	₹/kg	4000	kcal/kg
Furnace Oil	29.75	32	30.82	₹/l	10500	kcal/kg
Diesel oil	37	38	37.33	₹/l	10800	kcal/kg
Wood	2.2	2.2	2.20	₹/kg	2250	kcal/kg

** Source: BEE Book-2 except for wood, taken from www.engineeringtoolbox.com*

Table 2.3: Fuel and Electricity Details in Wire-drawing Howrah Cluster

Wire Drawing units					GCV* or Conversion	
				Unit	Average	Unit
Fuel	Price paid by the Wire-drawing Units					
	Min	Max	Average			
Electricity	4.98	9	6.11	₹/kWh	860	kcal/kWh
Diesel oil	39	39	39.00	₹/l	10800	kcal/kg
Wood	2.5	2.5	2.50	₹/kg	2250	kcal/kg
LPG	33	33	33	₹/kg	12024	kcal/kg

* *Source: BEE Book-2 except for wood, taken from www.engineeringtoolbox.com*

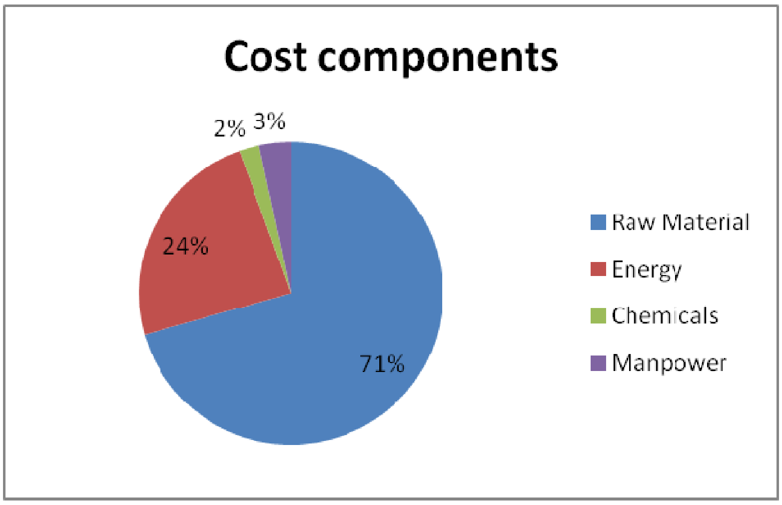

Figure 2.7: Share of Cost Inputs in a Typical Galvanizing Unit

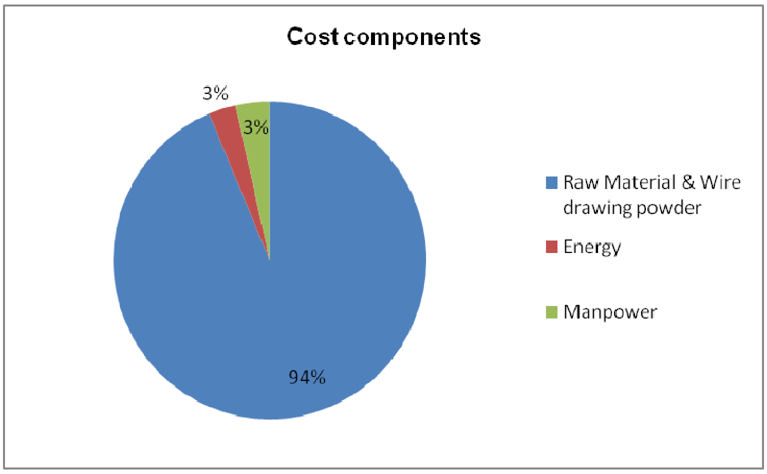

Figure 2.8: Share of Cost Inputs in a Typical Wire-drawing Unit

The major utilities in Galvanizing Units includes the oil and/or coal and/or LPG fired furnaces, blowers for air intake to the furnaces, oil burners, electric oil pre-heater, electric motor driven EOT cranes, a diesel generator set for back up power supply and lighting loads. The electricity is the minor utility, only 1% to 10% of cost of fuel. The blowers are driven by electric motors. In addition, there are electric oil pre-heater machines, EOT cranes, lights, fans and water pump that consume electrical energy. The diesel generator (DG) set in this galvanizing unit is used for back up power in case there is a power failure. However, it was said that the power interruption is not so frequent and during that period, normal only essential activity is maintained. The management as a result are normally much less interested in any improvement of energy efficiency of DG sets with compared to furnaces.

The major utilities includes the electric motors operated wire drawing machines, pointer machine, grinding machine, exhaust fan (low rating) as well as butt-welding machine, etc. The electricity is the principal utility in Wire-drawing units. All the Wire-drawing machines are driven by electric motors. In addition to electric motors there are butt-welding machines, grinder machines, lighting, fans etc which consumes electrical energy. Many units have Diesel Generator sets mainly for emergency use. Production process in most cases (except if it is related to annealing by induction furnace) is completely halted during non-supply of power from grid, as otherwise it would not be cost effective.

2.2.1 Types of fuels (Fossils, Biomass, Waste, Byproducts, Etc) used and prices

The major fossil fuels used in the galvanizing and wire-drawing industries of the Howrah cluster are furnace oil, diesel oil, wood and coal. Electricity is also used in significant amounts for the running of the units.

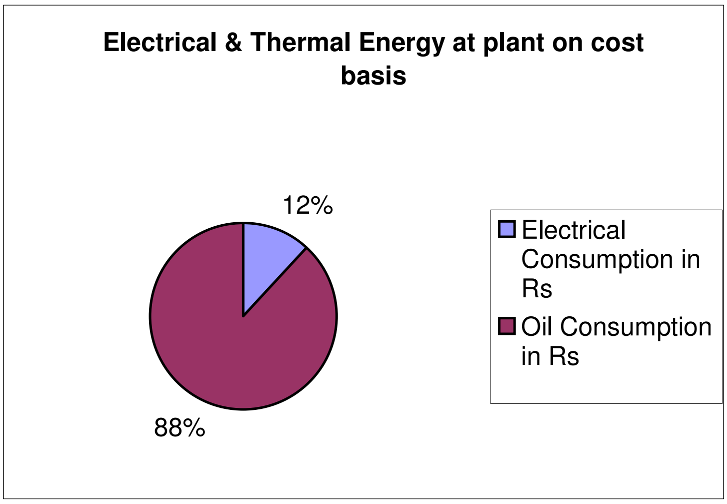

Figure 2.9: Share of Annual Energy Consumption in a typical galvanizing unit

Fuels and Electricity Consumption in a Typical Unit

Table 2. 4. Fuel and electricity consumption

Information on a Galvanizing Unit	Amount	Unit
Annual electricity consumption	59346	kWh/yr
Annual furnace oil consumption	85195	l/yr
Annual electricity consumption	291210	₹/yr
Annual furnace oil consumption	2555850	₹/yr
Total industry energy bill	2847060	₹/yr
Average electricity cost	4.91	₹/kWh
Furnace oil cost	30	₹/l

Table 2.5: Fuel and Electricity Consumption in a Typical Wire-drawing Unit

Information	Amount	Unit
Annual electricity Consumption	295310	kWh/yr
Annual electricity consumption	2487875	₹/yr
Annual LPG consumption	135000	kg/yr
Average electricity cost	8.42	₹/kWh
LPG cost	33	₹/kg

Table2.6: Fuel and Electricity Consumption in Howrah Cluster

Information	Unit	Values		
		Galvanizing	*Wire-drawing*	*Total*
Total electricity consumption	kWh/yr	867325	2243290	3110615
Total diesel oil consumption	l/yr	19200	12000	31200
Total furnace oil consumption	l/yr	731695	---	731695
Total coal consumption	kg/yr	1161000	---	680833
Total wood consumption	kg/yr	600000	300000	900000
Total LPG gas consumption	kg/yr	---	135000	135000

2.2.2. Study on Specific Energy Consumption (SEC)

Table 2.7: Specific Energy Consumption in Galvanizing & Wire-drawing Units

		Specific Energy Consumption			Unit
		Min	Max	Average	
Galvanizing	Electrical	5.12	120	46.15	kWh/Ton
	Thermal	200370	579600	385978	kcal/Ton
Wire Drawing	Electrical	30	868	308	kWh/Ton
	Thermal	135	511	323	kcal/Ton

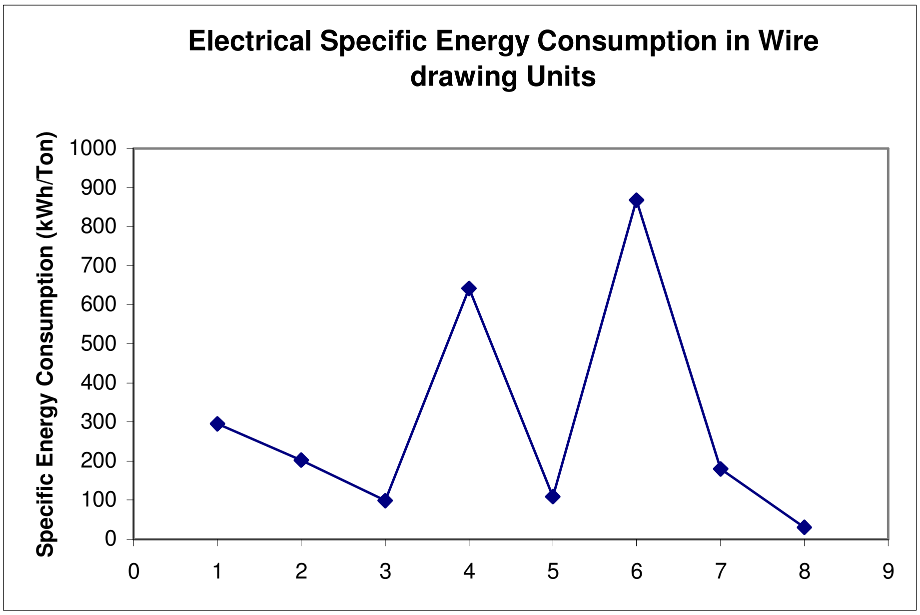

Figure 2.10: Electrical Specific Energy Consumption in Wire drawing Units

Specific energy consumptions are found to vary widely for eight-selected wire-drawing and seven selected galvanizing processes as shown in the figures. This is because the variation in size of units, size & type of job, fuels types and volume of process, as, some of the Galvanizing units have fabrication activity as a part of the process.

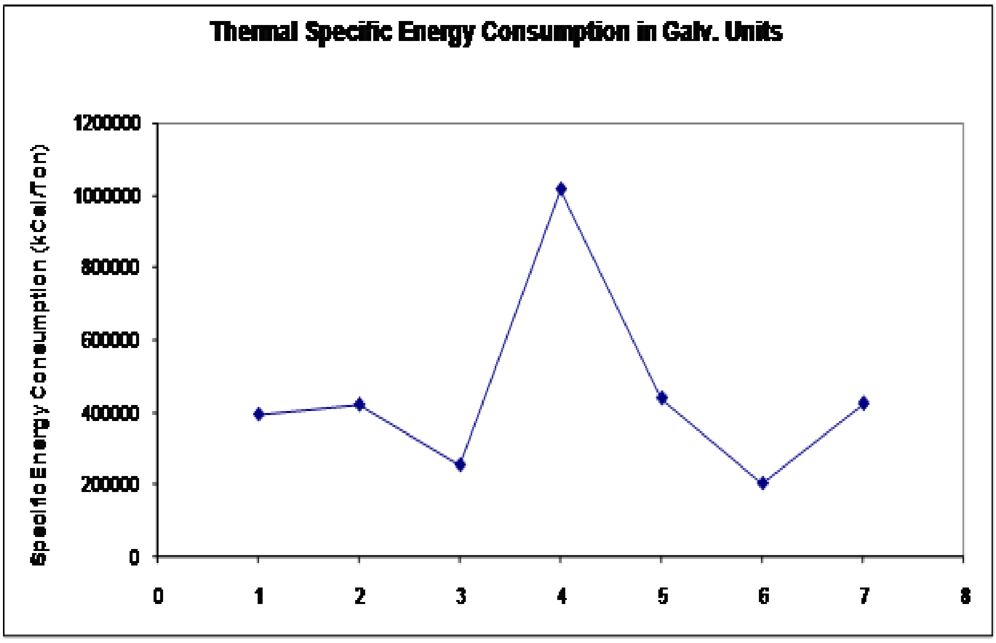

Figure 2.11: Thermal Specific Energy Consumption in Galv. Units

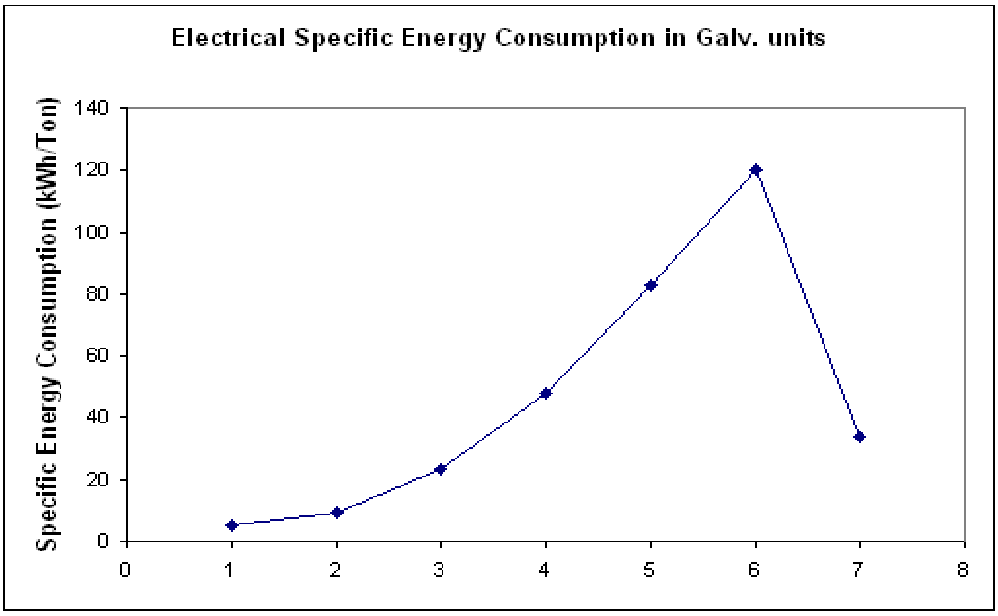

Figure 2.12: Electrical Specific Energy Consumption in Galvanizing units

2.3 Manufacturing Process/Technology Overview

2.3.1 Process technology

2.3.1.1 Process of Galvanizing Units

Hot-dip galvanizing is an old and well known process of applying zinc coating to iron or steel surface for protection against corrosion. The Zinc coating firstly protects the base metal by acting as an impervious shield between the metal and the atmosphere and secondly affords sacrificial protection even when moderately sized areas (4 mm dia, for example) of the base metal surface are exposed. Bureau of Indian Standards introduced Indian Standards for Recommended practice for hot-dip galvanizing of iron and steel as IS : 2629 – 1985, which is used here as reference for authenticity.

When a thoroughly cleaned article is immersed in a galvanizing bath, the metal surface reacts with molten zinc to form a zinc-iron alloy. As the article is withdrawn from the bath, it picks up pure zinc which solidifies on cooling and forms the outer layer. The intermediate alloy layer provides a strong bond between the ferrous base material and the pure zinc and also resists corrosion and abrasion in the event of the pure zinc layer being removed. Under same conditions of process or composition of the material the whole coating may consist of zinc-iron alloy layers.

The galvanizing process can be grouped together under three categories, namely (a) wet process, and (b) dry process, and (c) a combination of dry and wet process consists of cleaning base steel surface by first oxidizing and subsequently reducing the surface oxides under controlled atmosphere or by any other in-line cleaning method. The strip is heat-treated in line annealing/normalizing furnace followed by continuous feeding through molten zinc bath and passivating treatment by suitable agent like chromic acid. After galvanizing, when the sheet emerges from the zinc bath, the excess molten zinc on them is wiped off by air or gas jets in larger units. There is no fluxing in this process. Continuous galvanizing process has got advantages over both wet and dry processes with respect to high productivity, control of coating thickness, uniformity of coating along the length, better coating adherence, less dross formation, better surface appearance, etc. However, in Howrah cluster Galvanizing SMEs dry intermittent process because of the varied sizes of items to be galvanized. Some of the common terminology used in galvanizing process are as following:

Ash – A mixture of zinc oxide and varying quantities of metallic zinc. The former is formed as a result of oxidation of clear zinc on the bath surface and when the oxide is skimmed off; a certain amount of metallic zinc gets entrapped and removed along with it.

Dross – An intermetallic compound (FeZn13), which is a complex mixture of zinc and iron, forms in the galvanizing bath as a result of thee reaction of molten zinc with iron or iron salts and settles down at the bottom of the bath. Zinc content in dross will vary between 94 to 97 percent depending on the quantity of metallic zinc entrained in dross during its removal from thee pot. Dross should be allowed to settle at the bottom of the zinc bath, and should not be disturbed more than necessary during the dipping operation. A lead bed may be maintained as it assists in drossing.

Flux – A chemical compound applied in the form of an aqueous solution and dried on to the work in the dry process of spread as a molten blanket over the zinc bath in the wet process. The primary purpose of the flux is to help in keeping the surface of both work and molten zinc free from oxide at the time of reaction. In both the galvanizing processes fluxing helps maintaining the surface of work free from oxides.

Over-Pickling – The undue attack of the underlying ferrous surface by the pickling solution after the removal of scale.

Inhibitor – A substance added to pickling solution to prevent undue attack on clean metal without affecting the scale removing property of the pickling solution.

White Rust - A white corrosion product, mainly containing zinc oxide and basic zinc carbonate, that accumulates on the galvanized surface exposed to water film or moist atmosphere.

Wetting Agent - A substance added to pickling and prefluxing solutions to facilitate wetting of the work surface.

Galvanizing Bath- The molten metal in the galvanizing bath should contain not less than 98.5 percent by mass of zinc. The control of bath temperature is essential if the quality of the product is to be consistent and zinc is to be used economically. Article should be galvanized at the lowest possible temperature which will allow the free drainage of zinc from the work piece during withdrawal. A low temperature reduces the formation of ash and dross, besides safeguarding the pot and conserving fuel. The bath temperature may vary from 440 deg C to 460 deg C and a working temperature of 450 deg C is commonly used. The temperature of the molten metal should not ordinarily exceed 475 deg C to prevent excessive attack of molten zinc on the work as well as on the pot. In case of high silicon steels, a higher galvanizing bath temperature of 550 deg C is adopted in order to obtain normal coating mass- the behaviour of silicon steels at 550 deg C is similar to that of ordinary steels at the normal galvanizing temperature at 450 deg C. However, for high temperature galvanizing, top heated ceramic bath are generally used.

Aluminum Additions – Aluminum may be added to the galvanizing bath the dry process to the extent of about 0.005 percent (0.007 percent Max) (0.05-0.07 g/kg of zinc) to reduce the rate of article. In the continuous strip galvanizing process, addition of aluminium is made in the bath in the form of Zn-Al alloy to maintain aluminium between 0.12 to 0.20 percent to control alloy layer thickness and thereby imparting better adherence. Lead is also added in the form of Zn-Pb alloy to provide spangle on the surface.

Steps for galvanizing involve the following:

Cleaning – If an article is contaminated by oil, grease or paint, pretreatment in special solvents will be necessary for their removal. Several proprietary reagents are available. Generally a sodium hydroxide in 100 litres of water is used at a temperature kept between 85 and 90 deg C for 1 to 20 minutes, depending on the nature and degree of contamination. Immediately after degreasing, the work should be rinsed in hot water (60 deg C) followed, if possible, by a final rinse in cold running water. Grey iron and malleable iron castings if not properly cleaned before annealing, develop burnt-on and patches at the surface which are not removed by normal pickling.

Pickling – Both hydrochloric acid and sulphuric acid solutions may be used for pickling. Hydrochloric acid is used at room temperature whiled with sulphuric acid best results are obtained when it is hot (60 to 80 deg C). Hydrochloric Acid Solution (100-150 g/l) – Dilute technical grade acid conforming with an equal volume of water. The actual concentration of hydrochloric acid solutions and the time of immersion will depend on the nature of the work to be pickled. Sulphuric Acid Solution (100-150 g/l) – Dilute 6 to 8 ml of technical grade acid conforming 100 ml. The actual concentration of sulphuric acid solution, the temperature of the bath and the time of immersion will depend on the nature of the work to be pickled. A suitable inhibitor should be used with acid.

Agitation – Mild agitation of the work in the pickling tank reduces the time of pickling. Rinse or lower the work once or twice to change the acid layer in contact with the work. Air agitation is not recommended.

Rinsing – After pickling, the article should be rinsed in running water . Two rinse tanks are preferable, the water cascading form one into the other, that is cascading from the second tank into the first tank.

Fluxing – The rinsed article, in the dry process, is dipped in a strong solution of zinc ammonium chloride (ZnCl2, 3NH4Cl), although ammonium chloride is also used to a certain extent. The actual work being undertaken and on individual circumstances. The working level is generally between 200 to 400 g of zinc ammonium chloride per litre. Some wetting agent is usually added to the flux solution. The temperature may range from room temperature to 80 deg C. When dry galvanizing is adopted, the article shall be thoroughly dried after fluxing over a hot-plate or in an air-oven. The temperature should be about 120 deg C and should not exceed 150 deg C as the flux decomposes above this temperature. In the wet process, a deep flux cover is used on the zinc bath and the work is immersed through the flux layer with or without fluxing. In this case drying is not considered essential. The recommended time limit for galvanizing is within an hour of fluxing.

Immersion – The work should be immersed as rapidly as possible but with due regard to operator's safety. In case of continuous strip galvanizing the rate of immersion/withdrawal is dependent on the thickness of the strip and line speed governed by furnace design. The time of immersion for a job depends on several factors like its chemistry, size, thickness, type of job, etc. In most cases the article shall be left in the bath until it reaches the temperature of the bath which is usually indicated by the stopping of the boiling action. It is then withdrawn without much delay.

Withdrawal - The rate of withdrawal, which determines the thickness of the unalloyed zinc layer left on the article, varies according to the type of the process being operated and the form of article. With long article for which withdrawal occupies a large part of the total handling time, speeds are necessarily maintained at higher levels to ensure a reasonable rate of production. It is better to use special jugs and carries for dipping and withdrawing the work in batches. The rate of withdrawal should be controlled so that zinc drains freely from the surface. Articles are withdrawn through a bath of clear zinc to avoid contamination by flux. However, withdrawal through a flux blanket has also its advantages in the removal of surplus zinc from the surface and in producing a uniform coating at relatively higher speeds. In the latter case it is recommended to quench the material to remove flux residues.

Water Quenching - Where the article is withdrawn through a flux blanket, the quench water needs to be changed frequently to prevent thee accumulation of corrosive salts. For this purpose tanks having overflow weir may be used with advantage. Light gauge articles should be spun quickly through the surface of water so that they retain sufficient heat after quenching to enable quick drying. Heavy articles retain sufficient heat for drying.

Centrifuging – Small articles handled in baskets should be centrifuged to remove excess of zinc immediately after galvanizing while the coating is still in the molten condition. The quality of the finish depends on the rapidity with which the material is transferred from the galvanizing bath to the centrifuging. It is also important that the centrifuge should be powered by a high starting torque electric motor to give rapid acceleration to peak speed within 2 to 3 seconds. After centrifuging, the articles should be immediately tipped into water to allow the coating to set and prevent the articles from sticking to each other.

Thread Brushing – Thread on articles which are unsuited for centrifuging shall be cleaned with a rotating wire brush immediately after galvanizing and before the coating sets. This process reduces the thickness and the protective value of the coating. It should only be confined to the threaded portions of the article.

Post- Treatment – The zinc coating on freshly galvanized surfaces when exposed to humid, poorly ventilated conditions during storage and/or transport react with the moisture, carbon dioxide, oxygen, etc, in the atmosphere forming a mixture of salts which are white in colour. This is known as 'white rust' or 'wet storage stain'. Normally a post-treatment like chromating is recommended. This is a temporary treatment and retards white rust attack. The chromating solution contains up to 1 percent sodium dichromate and half percent sulphuric acid solution – the solution is kept at room temperature and its temperature should never be allowed to rise above 65 deg C. The galvanized articles are dipped into the chromationg solution after the galvanizing and water quenching operations.

In case of continuous strip galvanizing the strip is sprayed with chromating solution, such as chromic acid and properly spread uniformly by means of squeezer rolls. Temperature of the chromic acid bath is maintained around 70-75 deg C.

Stacking – Article should be stacked immediately after quenching to avoid flaking of coating. The galvanized articles should be allowed to dry before any further handling operation.

A commonly practiced production process involves seven stages as shown in Figure 2.14. Many galvanizing industry have a fabrication unit used for fabricating the galvanized electrical transmission tower materials and such items for the use of their clients.

2.3.1.2 Process of Wire Drawing Units

The production process may involve several sections comprising of annealing furnace, extrusion unit, casting unit, machining unit, shaping, wire-drawing and grinding units. Wire-drawing unit may have several smaller units (internally called Unit-1, Unit-2, etc) almost independent but linked for mutual benefits. Wire-drawing process is essentially driven by electric motors which are the main focus area of energy audit and savings. For example, unit 1 may have extrusion units in which thin and thick both type of copper wire rods are drawn. Simultaneously, the unit-1 has also a machining unit in which different lathe machines do different kinds of machining jobs. The main Wire-drawing unit that is under unit-1 has a number of different kinds of Wire-drawing machines that are used to draw Copper wires of both thick and thin types. Typically there could be 3-5 primary wire-drawing machines that are used to draw copper wires in a series to attain the necessary reduction in cross section. For example, input of 3 gauge copper wire is drawn by passing it through a series of double dies of specific gauges (3-14 gauges) for thick MS Wires and (14-25 gauges) for thin copper wires. Each stage can reduce the cross-section by one gauge number (say 3 to 4) as it passes through each die. Single dies are also used employing smaller motors or when less reduction in cross-section is required. The modules of one stage can comprise of the following:

Figure 2.15 presents a schematic description of a draw bench for fine wire drawing. The equipment is an assembly of six major distinct modules. (Module #6 is omitted.)

Module #1, the central module, is the frame and bath combination, containing the die and die holder. The wire and the die are immersed in the bath containing the lubricant. In a more sophisticated unit, module #1 will also include a pump to circulate the lubricant, a filter to clean the lubricant, and when desired, a temperature control system. In most of the cases in the Howrah cluster, dry powder (Uni-Lab powder of Predington company based in Mumbai or Grommet–44, as it is commonly termed in the Wire-drawing industry) is used as lubricant.

Module #2 contains the pay-off spool which feeds the wire into the drawing die.

Module #3 (optional and present is most of the cases) is the tensiometer, a standard sensor that measures the tensile load on the emerging wire.

Module # 4 contains the entire spool pick-up system. The spool is mounted directly on the shaft of a 'step' or induction motor that provides the moment (and force) to draw the wire. The motor rating has been found to vary from 5 hp to 200 hp. The speed of the motor is controlled only is some units those are larger/ sophisticated. Controlling of AC slip-ring induction motors were by thyristors or VFD. In some cases, DC motors of even 200 hp are used. In other cases, mostly a jockey mechanism is utilized to maintain tension of the wire as it is drawn from one coiler drum to the other, else, in a few cases, a direct drawing machine is utilized where the wire is drawn through a series of dies directly.

Module #5 (optional) comprises the computer control system, and includes data collection, analysis, and display. This module is present only in more sophisticated units which are less than 15% in Howrah cluster.

Module #6 (Optional) comprises a lubricant circulation, filtration and temperature control. For various uses the system design may vary. This module is not presented where dry powder is used as lubricant.

In a typical case, the ultimate finished product is of 14 gauges of thick Copper Wires and 25 gauges of thin Copper Wires. The size variation of different dies for producing different gauges mainly depends on the end-customer's requirement. A series of drum for coiling the wires coming out of the die are used. These coiler drums are driven by electric motors that are of induction type.

The finished products of drawn wires, often dipped of some time in chromate solution to protect it against weather condition till it reaches the user, are stacked on the steeper from where the finished goods are dispatched to the end customers. The finished wire products are mainly supplied to the downstream industries such as Telecommunication industries, nails, nuts & bolts, Switchgear manufacturers, Electrical Panel manufacturers, Steel plants, Relay manufactures, Electric motor manufacturers and other different companies in the electrical sector and also to the local market.

2.3.2 Process Flow Diagram

2.3.2.1 Process Flow Diagram for Galvanizing Units

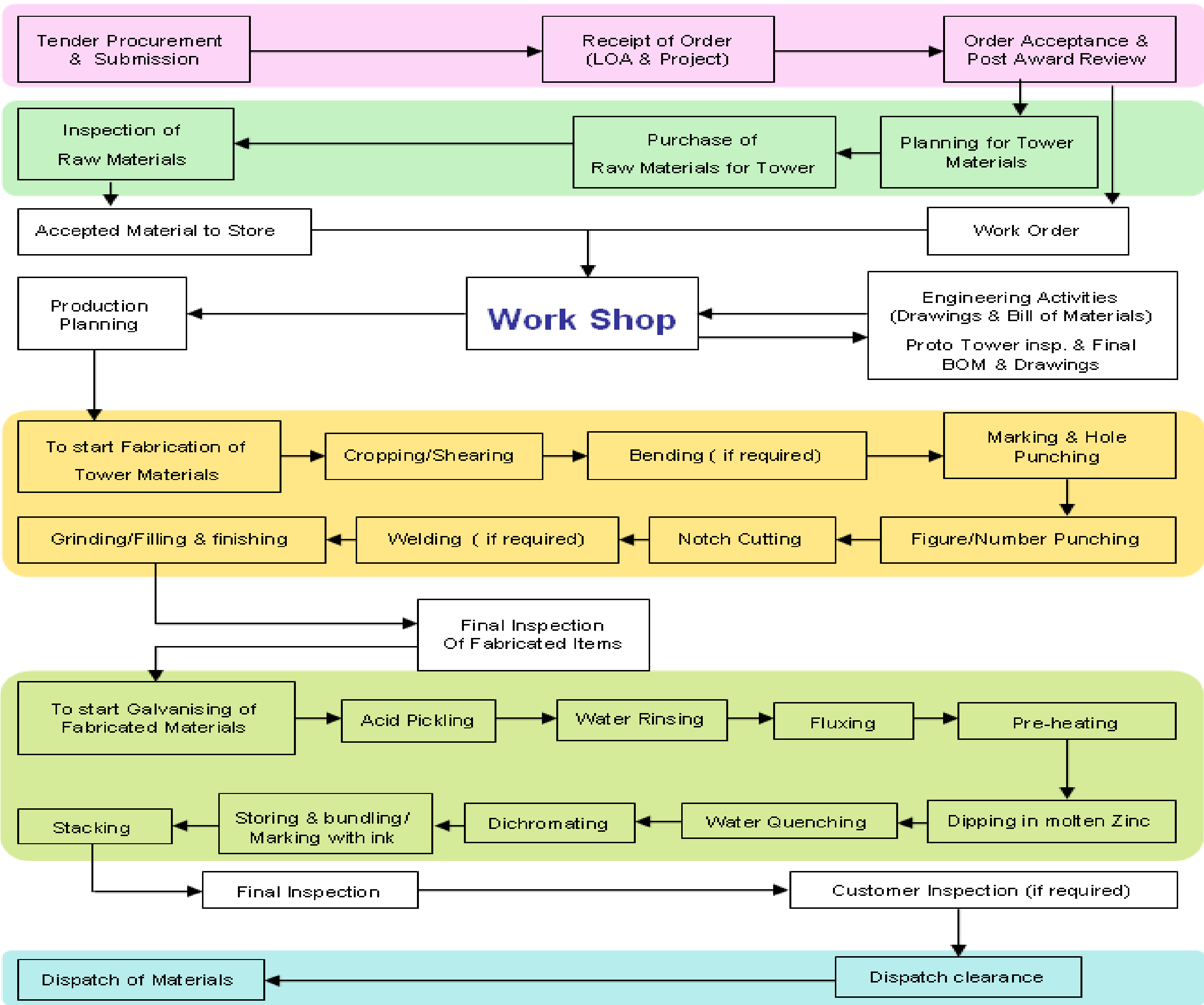

Figure 2.13: Galvanizing Process Flow Chart in a Typical Unit with Fabrication Activity

A schematic step by step process diagram is placed below showing the main activities as discussed above. The job is however found to be handled manually in Howrah cluster. While maximum energy use is in Zinc Bath, each step involves either low temperature heating or pumping or both, i.e. involving energy use.

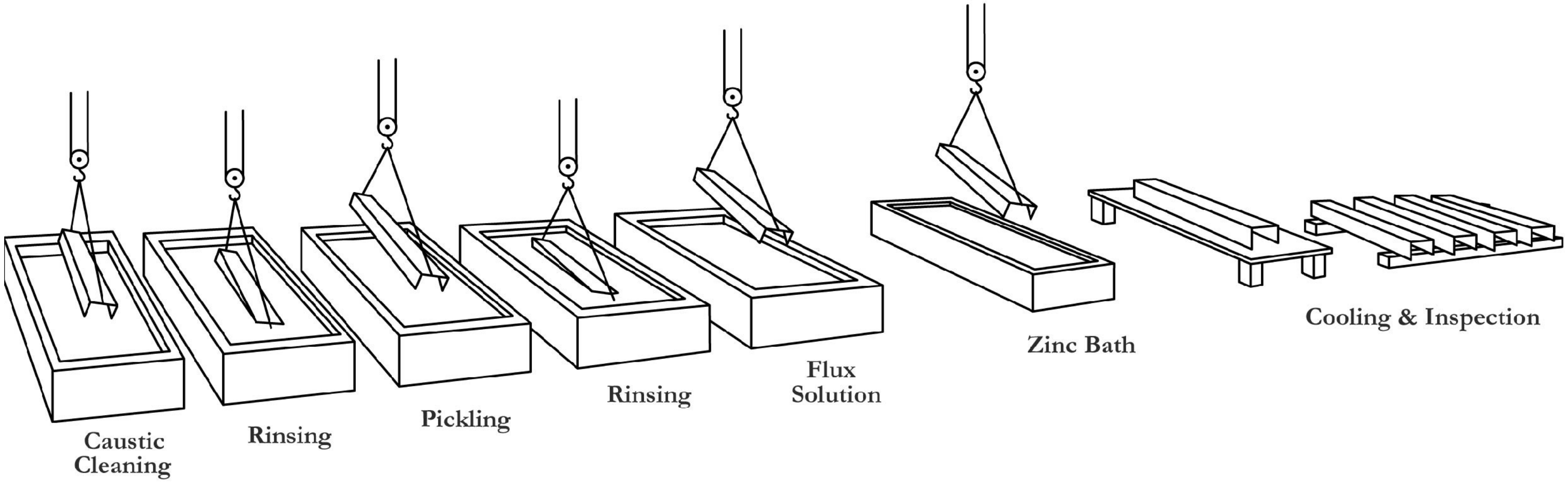

Figure 2.14: Galvanizing Process Flow Chart in a Typical Unit without Fabrication Activity

2.3.2.2 Process Flow Diagram for Wire-drawing Units

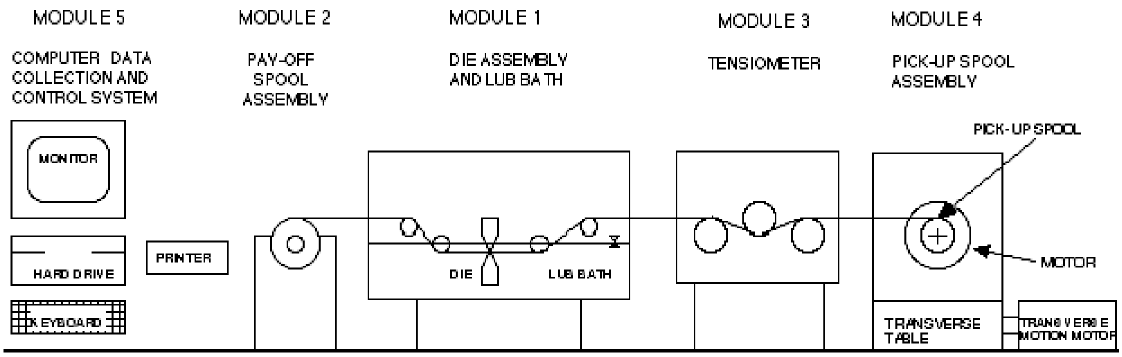

Figure 2.15: Schematic of a Typical Wire-drawing Bench

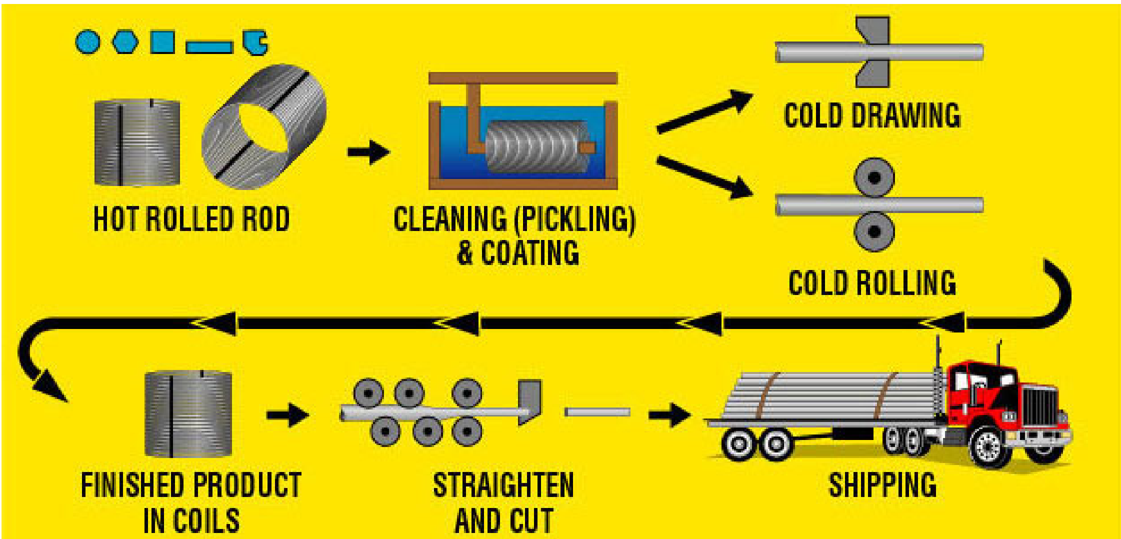

Figure 2.16: Wire-drawing Process Flow Chart in a Typical Unit

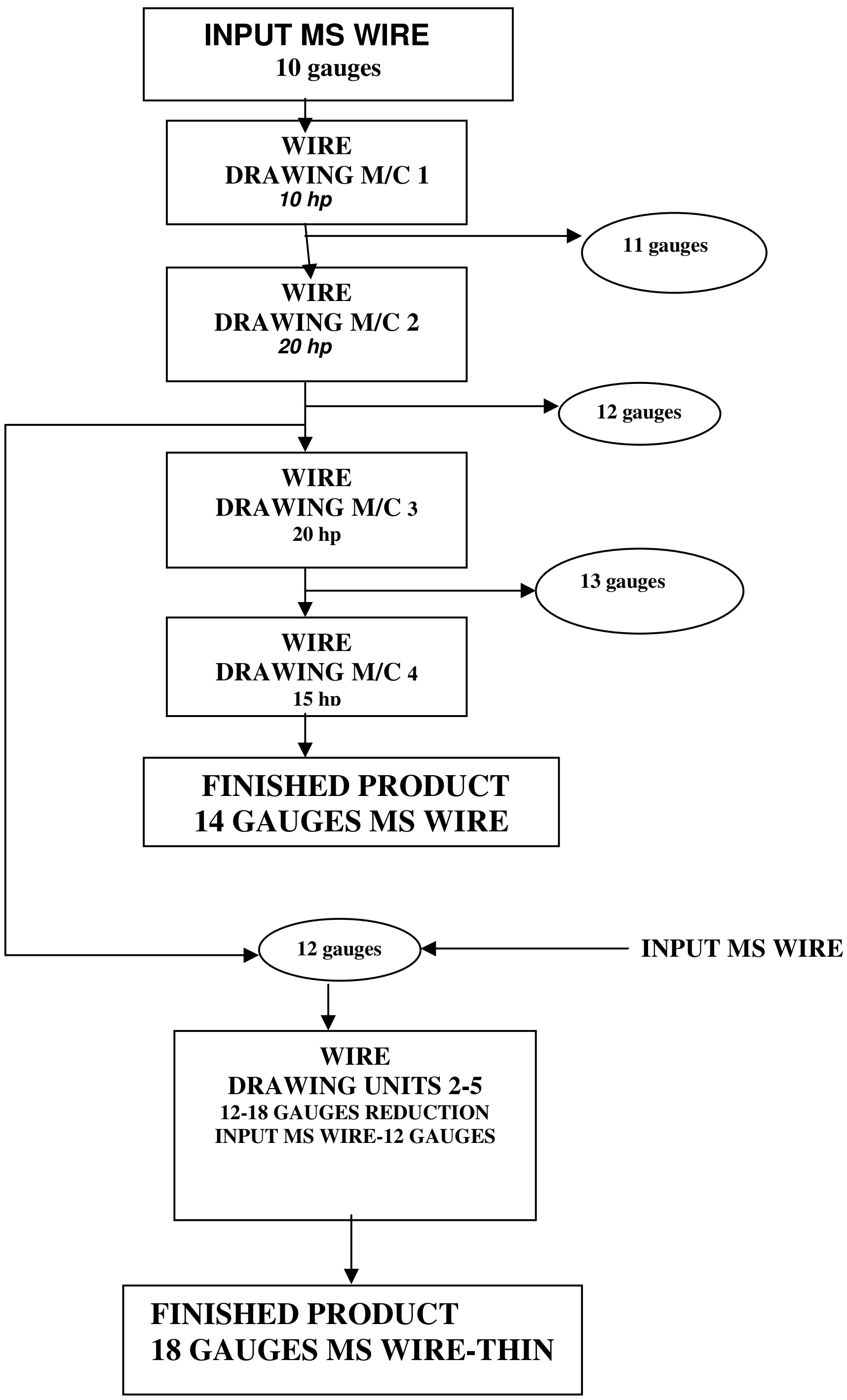

Figure 2.17: Wire-drawing Process Flow Chart in a Typical Unit without Annealing

2.4 Issues related to energy usage and conservation and barriers to technology up-gradation

The smaller industries in India have some barriers in implementing energy conservation measures. The typical units do not have trained personnel to identify and evaluate energy efficiency technologies and products. They also need help in ascertaining and managing technical and financial risks. A few such problems in up-gradation of technology are as follows.

1) Ignorance about energy efficiency
2) Energy efficiency low on priority list
3) Lack of technical information and instrumentation
4) Lack of trained manpower
5) Insufficient funds to implement conservation measures

Some of these problems and the ways to overcome these are elaborated here.

2.4.1 Energy availability

Electricity and other fuels such as coal, wood, FO and diesel are available in the cluster on commercial basis. As it is happening elsewhere, the cost is spiraling high. The quality of available power is not up to the mark as while performing the audit, a number of three phase power quality analyzer measurements have been found to have low and fluctuating voltage particularly during the peak hours, phase unbalance in LT and in some cases HT supply, higher harmonics, etc. The issue of power failure is however not much matter of concern.

2.4.2 Technological Barrier

A majority of the owners of the Galvanizing and Wire Drawing Industries in the Howrah cluster do not have sufficient knowledge of energy efficient measures. Further, they are reliant on the local vendors, service companies and in-house personnel to assist them with technical information. These local experts are more inclined to use the tried and tested technology than try out newer methods which they themselves are not aware about at times. Such a situation makes it difficult for the owners to implement the most effective technical measures.

To overcome the problem, the entire management has to be made more aware of the benefits of improving energy efficiency and the ways to go about it.

2.4.3 Financial Barrier

Many of the units in the Howrah cluster have low turnovers. The owners of those units are therefore reluctant to invest even in the measures which require less capital. The problem is compounded by the fact that the measures are rather new to the area, thereby providing less assurance of returns.

This problem can be solved to a certain extent by suggesting banks which are willing to provide loans at special rates to cater to the energy efficiency measures. Spreading awareness would also help significantly in creating the drive among owners to find ways of financing their measures.

2.4.4 Other Barriers and Their Possible Overcoming

Technical personnel in employed in the units are generally skilled works but not engineers. Thus the production process remains traditional. This is one of the main hindrances in adopting newer technology. Specialized training among the workforce and local experts can circumvent the problem significantly. Effective dissemination can enhance replication potential in the various units. The gains obtained by one plant can inspire other units to follow suit.

The local industry associations would be of great importance to overcome these barriers in the following way:

a) Promote the spirit of fraternity among members to improve professional efficiency.

b) Create awareness about the fast changing technological environment for better productivity and quality.

c) Provide a common platform to it's members to exchange their achievements, ideas, experiences and problems.

2.5 Cluster Association Details

There is no industry association solely for the cause of either Galvanizing or Wire-drawing Units or both. However, there are two industry associations one operating in the Howrah district, viz. Howrah Chamber of Commerce and Industry (HCCI) and other in the state of West Bengal, viz. Federation of Small and Medium Industries (FOSMI), West Bengal, who have activities that covers some member units in the cluster. There is another national level industry association, viz. Bengal National Chamber of Commerce and Industry (BNCCI) who have much less direct activities with the Galvanizing or Wire-drawing Units in the Howrah Cluster, but also help IISWBM, along with other two aforementioned Chambers for the BEE SME project.

Federation of Small and Medium Industries (FOSMI), West Bengal, is the largest organization in this part of the Country representing the needs of small and tiny enterprises, with a membership of over a thousand entrepreneurs. It also has as affiliated members twenty dynamic SSI Associations, which represent groups of enterprises in different segments. The contact persons are:

Mr. Biswanath Bhattacharya, President (M: 98310 08063)

Mr. Gautam Ray, Vice-President (M: 9831080469)

Mr. J N Ghosh, Representative, Galvanizing & Wire-drawing Units (M: 9830959803)

FEDERATION OF SMALL & MEDIUM INDUSTRIES, WEST BENGAL

23, R. N. Mukherjee Road, Kolkata-700 001.

Phone: +91 33 2248 5114; 2231 8382; 2231 8446; Fax: +91 33 2210 4075

E-mail: fosmi@cal3.vsnl.net.in; Website: www.fosmi.org

Howrah Chamber of Commerce and Industry (HCCI) originated from the zeal to overcome the barriers during 1980s and 1990s when the business and industry were having a plethora of problems with power shortage, labour unrest, raw material shortage, financial constraints in Howrah district, and there was no forum or association to take up the causes of business community of the district and to bring them in the notices of the State and Central Government. The institution, since its inception in 1991, has now evolved into a premier Chamber of Commerce & Industry of the country with unimpeachable credentials recognized by both Central land State Government. The contact person is:

Prof. Sankar Kumar Sanyal, President (Mobile: 9831224445)

HOWRAH CHAMBER OF COMMERCE AND INDUSTRY (HCCI)

Laxmi Niketan, 243, G.T. Road (N); Liluah, Howrah - 711 204, West Bengal

Ph. : 033-2654 3727 / 2654 3314; Fax : 033-2654 3314;

E-mail: howrahchamber@gmail.com; sankar_sanyal@yahoo.co.in;

Website : www.howrahchamber.com

DICs are the Nodal Offices towards development of Industries. All intending entrepreneurs are welcome. DICs also depute Industrial Development Officers at the Block Office. The address of the DIC Howrah is placed below:

DISTRICT INDUSTRIES CENTRE, HOWRAH

24, Belilious Road, P.O. & Dist. Howrah, Pin – 711 101

Phone: 2666-7859 / 7858 / 8864; Fax : (033) 2666-7859.

E-Mail: dic_howrah@mantraonline.com

Website: http://howrah.gov.in/Templates/industry.html

Energy Club and Association of Energy Engineers (AEE) India Chapter were the first such units of their kind fostering dissemination of good energy efficiency practices and knowledge in the region since 2000. Both of them are initiated and hosted by the Indian Institute of Social Welfare and Business Management (IISWBM), the oldest management education institute in India, what started energy management course at master level since 1993 and conducted more than 120 energy studies. The contact persons are:

Prof. (Dr.) S N Ray, President Association of Energy Engineers (AEE) India Chapter and Director, IISWBM, College Square West, Kolkata – 700 073. Website: www.iiswbm.edu and Secretary, Energy Club and Association of Energy Engineers (AEE) India Chapter; Email: binoykchoudhury@gmail.com; Mobile: 9433153009.

West Bengal Renewable Energy Development Agency (www.wbreda.org) and West Bengal Green Energy Development Corporation are the other two premier organizations, working for the cause of energy efficiency and renewable energy application in the state. The contact persons are:

Shri S Bhattacharya, Director, WBREDA, Bikalpa Shakti Bhavan, J-1/10, EP & GP Block Sector-V, Salt Lake, KOLKATA - 700 091. Email: sushobhan1234@rediffmail.com

Phone: 2357 5038, 5348 (PBX) 2357 5347, 5037 (Direct); Telefax: 2357 5347, 5037

Dr. S P Gon Choudhury, Director, WBGECL.

Organizations such as Ministry of Small & Medium Enterprises (MSME), Small Industries' Development Bank of India (SIDBI), Indian Renewable Energy Development Agency (IREDA), the Japan International Cooperation Agency (JICA), etc. have various schemes that are given in more detail in Annexure 5.

CHAPTER THREE

3.0. ENERGY AUDIT AND TECHNOLOGY ASSESSMENT

3.1 Methodology adopted for Energy use and technical study

A team of competitive engineers, having experience in the Galvanizing & Wiredrawing sector, researcher, post-graduate aspirants in Energy Management and technicians was involved in carrying out the study at this sector. The study was carried out in different phases.

The general scope was as follows:

- Identify the potential Galvanizing and Wiredrawing Units in the Howrah cluster and motivate them for energy conservation studies under the BEE SME program by explaining the benefit
- Identify areas of opportunity for energy saving and recommend the action plan to bring down total energy cost
- Identify areas of energy wastages in various sections and suggest measures for minimizing energy losses or suggest alternative energy saving measures that can effectively replace inefficient process
- Conduct energy performance evaluation and process optimization study
- Conduct efficiency test of equipments and make recommendations for replacement with more efficient equipment with projected benefits
- Suggest improved operation & maintenance practices
- Provide details of investment for all the proposals for improvement
- Evaluate benefits that accrue through investment and payback period

3.2 General Methodology

The study was conducted in 3 stages:

- **Stage 1:** Preliminary Energy Audit (PEA) of the plant to understand process energy drivers, assessment of the measurement system, assessment of scope, measurability, and formulation of audit plan
- **Stage 2:** Detailed Energy Audit (DEA) by on-site study of the system and measurement
- **Stage 3**: Off- site work for data analysis and report preparation

The three stages of the study are discussed as follows:

3.2.1 Preliminary Audit

A total of thirty preliminary energy audit studies were conducted in this cluster. The purpose of preliminary audit was to

- Assess the energy conservation potential
- Make an assessment of the measurement system
- Finalize the schedule of equipments and systems for testing and measurement
- Arrange for the infrastructure requirements at site
- Ensure completion of the following measurement requirements
    - Check all the existing measurement and analytical facilities and assess additional requirements for measurement and testing needed for detailed audit
    - Make arrangements for making available additional instruments where portable instruments cannot be used
    - Make arrangements for providing tapings and connection points required for connecting portable instruments
    - Finalize the testing and measurement schedule
- Discuss and finalize the total project schedule

3.2.2. Detailed Audit

Fifteen detailed energy studies were conducted in Howrah cluster. The activities carried out by the team in detailed energy audit included:

- Study of the system & associated equipments
- Conducting field testing & measurement
- Data analysis for preliminary estimation of saving potential at site
- Site trials for further validation

The detailed audit consisted of system study to identify the energy losses (thermal/ electrical) and then to find solutions to minimize the same. This involved data collection, measurements/ testing of the system using calibrated, portable instruments, analyzing the data/ test results and identifying the approach to improve the efficiency. All the above were done by following standard codes. Audit methodology is depicted in Figure 3.1.

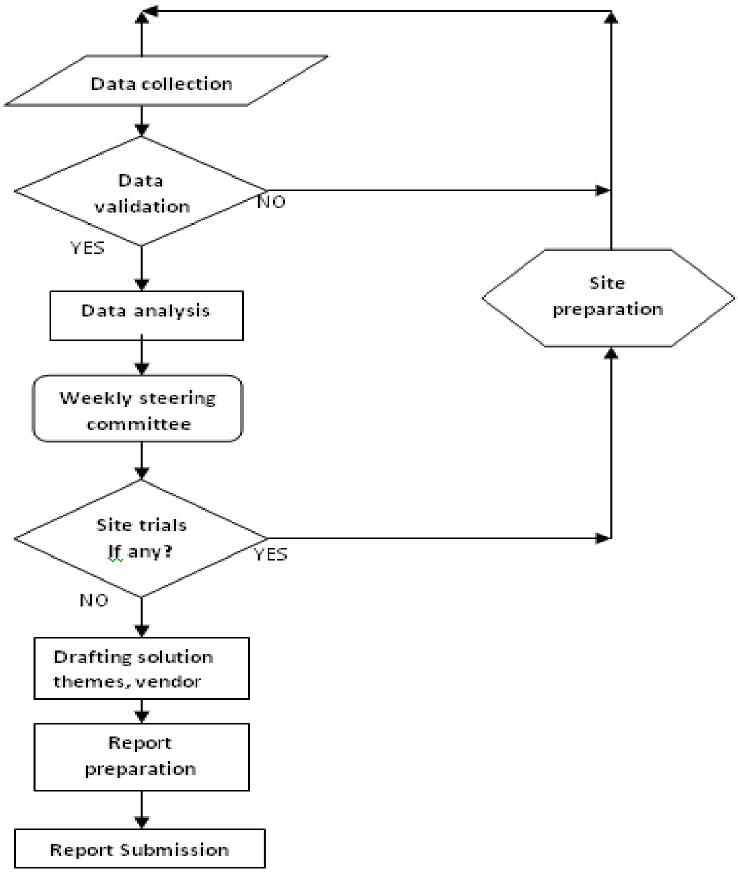

Figure 3.1: Audit Methodology

3.2.3 Post Audit Off- site Work

Post audit off- site work carried out included

- Revalidation of all the calculations for arriving at the final savings potential,
- Identify and articulate individual energy saving projects
- Vendor interaction
- Report preparation/ compilation and further discussion with the concerned unit to enhance acceptance of recommendations
- Acquiring BEE's acceptance
- Outlining procurement specifications for replacement hardware
- Energy saving project costing
- Prioritization of projects for implementation
- Technical support to interested units who started implementing some of the recommendations

3.3 Observations Made during the Energy Use and Technology Study

3.3.1 Manufacturing process and technology/ equipments installed

The Galvanizing & Wire-drawing sector in Howrah cluster has energy saving opportunities both in the process and utility side. During the energy audit carried out, it was observed that a few Wiredrawing units were performing fairly well in terms of energy efficiency; however, the Galvanizing units were marked with poor performance. The units which did well have adopted the latest energy efficient technologies available on both the process and utility side. Still there are large numbers of units that have potential to improve energy efficiency.

The technology for making the units energy efficient is available in the country and there are several vendors, some of the prominent ones being M/s Kirloskar Electric, Techmark Engineers & Consultants, M/s Swapan K Dutta PE, M/S EPCOS India Pvt. Ltd, M/S Asian Electronics Ltd, etc. There are three aspects of technology of the present sector in consideration so far. These are:

- Options that have largely been implemented by industry
- Commercially available technologies that are under active consideration
- Advanced technologies

The major technology improvements have been made possible due to the following:

- Material improvement
- Instrument improvement
- Technology transfer
- Global trends
- High competitiveness and awareness

A number of units have taken initiatives for technology up gradation with support from vendors in quite a few areas like:

- Replacing old motors with energy efficient motors to cut down the energy cost
- Installing capacitor banks to improve the power factor
- Waste heat recovery to processes (only in limited cases) requiring low heat and thereby replacing the fuel used for that purpose contributing to fuel cost savings.
- Using energy efficient lighting systems for better lighting in the work place by consuming less energy.

Most of the units in Howrah cluster are using old equipments and in the event of breakdown get they replaced either internally or locally. As such, the equipments installed:

- Do not meet the best efficiency levels available
- Are mostly over designed capacities leading to inefficient operating levels

3.3.2 Housekeeping Practices

Housekeeping Practices were found to be poorly maintained in the majority of the galvanizing & wiredrawing units in Howrah cluster. There were no specific guidelines of procedure or even standard operating practice (SOP) mentioned in any of the units for the operation of machines/ equipments. Records were found to be poorly maintained, no nameplate data of any equipment were visible, and there was no proper monitoring of parameters such as fuel consumption, leakages, etc, except only a few units. It was also observed that fuel such as Coal & Furnace Oil are being wasted because of spillage or leakage. The leaking and overflow of water from the system has lead to increased amount of water consumption. The insulation of furnace was found to be in bad condition. The practice of insulating the hot/ flue gas pipeline is very poor.

By improving the housekeeping/ operational practices in the galvanizing & wiredrawing sector, efficiency will improve by around 1-5%. Some of the suggested house-keeping practices are mentioned below:

a) A major fraction of solid waste generated can be minimized by practicing good housekeeping. The various in-house approaches to reduce the generation of solid waste are:

i. Good management of raw material storage facilities
ii. Application of cleaner technologies
iii. Use of waste heat recovery system
iv. Proper combustion of fuels
v. Proper handling of chemicals used in the process

b) Repairing all leakages, keeping taps closed and switching of utilities when they are not in use & cleaning the water tanks/ reservoir periodically.

Table 3.1: Housekeeping practices with associated benefits

Sort	This is very logical term in, which identification of the contents take place, data base of the products have been created and, then any kind of sorting take place just to arrange the products and removal of unwanted items. Classification of the products is necessary, which is called Red Tagging. It is important just to identify factors, right from whether it is needed, existing amount obligatory amount, occurrence of necessity, and so on.
Systemize	This step in 5S process consists of removal of unwanted items permanently and one more task that to be take place is decision that means you have to decide that what is required to be in what place. Place the items in such manner that you could retrieve them within 30 seconds of requirement
Brush away	Examine al the items on the daily basis. the process is not that much time consuming, but essential to clean up your workplace and most required in 5S. the conscientiousness to keep the office clean should be circulated between everyone in the group.
Homogenize	This important step of 5S involves the visual control, which is important to keep your organization well- organized and clean. It is a complete evaluation to improve the working conditions.
Self control	This step is quite essential, but critical because it involves all the discipline to ensure the 5S standards; it also takes charge of dedication and commitment.

3.3.3. Availability of Data and Information

A majority of the galvanizing & wiredrawing units in Howrah cluster do not have any instrumentation or data monitoring systems to monitor various operational parameters in processes/ equipments/ utilities. Few instruments are installed in some of the units in the cluster for monitoring of operational parameters in their units. Accuracy of readings from these instruments is also poor.

Very few entrepreneurs were able to provide their their energy consumption against production in the respective months.

3.4. TECHNOLOGY GAP ANALYSIS

The awareness for energy conservation has reached a stage where the galvanizing & wiredrawing units should take the initiative to adopt the energy efficient technologies. With the increase in global competition energy conservation and optimization is a good tool to bring down their energy cost and thus the overall manufacturing costs. Most of the units have outdated technologies; better and efficient technologies are available. Energy efficiency measures can be broadly classified into two categories:

1. Technology Up-gradation
   - Pumps, fans, and associated system
   - Piping
   - Furnace efficiency and fuel management
   - Lighting
   - Energy measurement, instrumentation and control system
   - Load optimization & rationalization
   - Rationalizing distribution system
   - Fuel substitution
   - Power factor and harmonics
   - Compressed Air System
2. Process Up-gradation
   - Process Technology up-gradation
   - Process synthesis
   - Process optimization
   - Process up-gradation
   - Automation
   - Work rationalization
   - Process integration
   - Heat recovery including heat exchanger networking
   - Alternative Fuel including Bio-mass

The table below provides the technology GAP analysis of the galvanizing & wiredrawing units in Howrah cluster with respect to the present status in the cluster and the better technology available for improving the energy efficiency.

Table 3.2: Howrah Galvanizing and Wire-Drawing cluster technology up gradation potential

Sl. No.	Technology/ Equipment	Present Status	Options available for EE improvement
1	Furnace	Low air pressure, excess air burners are being used in the process. It is dual a block type and blower and controls are separated from burner block. Further some of the outer surfaces of the walls on the furnace are found to have temperatures of 90 deg C and above.	Controlling the excess air to the furnace by monitoring the oxygen % with a sensor and adjusting the air going in appropriately. For insulation, there could be better materials attached to the walls to bring it down to even 60 degC.
2	Motors	The motors used in the cluster are normal motors of efficiencies between 30% and 80% with the loadings also being rather low at times. The power factors are generally lower than 80%.	The size of the motors could be adjusted to make the loading higher. While replacing the motors, energy efficient ones could be used to get upto 93% efficiency. Further capacitor banks could be put across these to improve the power factors. DOL soft starters could also help by reducing power consumption during starts.
3	Fans and lights	The present fans and lights are of the conventional type with high electricity consumption	The energy efficiency could be improved by using newer devices like the CFL, the T4 lights and occupancy sensors wherever relevant.

Table 3.3: Howrah Galvanizing and Wire-Drawing cluster technology gap assessment

Sl. No.	Technology/ Equipment	Present Status	Options available for EE improvement
1	Flue gas	At present, the flue gas is simply allowed to escape through the stack in the majority of the units.	The gas could be circulated through a specially designed Air Pre-Heater, thereby transferring a fraction of its heat to the combustion air. In some of the cases, this gas could be used even further to dry the job (thereby saving fuel).
2	Wire drawing machine type	The machines in place are typically conventional ones which have spools for each individual gauges which feed to the next stage.	Replace the machine with a new direct wire-drawing machine where the wire gauge is reduced without putting it through spools in the middle. The wire is pulled by a single motor and all the stages operate in a single drawing operation.

3.5. Energy Conservation Measures Identified

1) **ECM – 1 : Usage of Air Pre-heater to Recapture Heat from the Flue Gas and Pre-heat the Combustion Air**

Background

All the galvanizing units have furnaces. The flue gas from such furnaces was found to be simply let out at a temperature in the range of 400 to 600 °C and hence the thermal energy is wasted. This heat in the spent gas could be recovered and used to pre-heat the combustion air. As per thumb rule, every 23 °C drop in temperature would increase thermal efficiency of furnace by 1%.

Description and benefits of proposal

The IISWBM team designed an Air Pre-Heater for the purpose of using the waste heat. The scheme is shown in the Figure 3.2 and 3.3. In this design, the air to be heated is put in a cylindrical chamber on the outer side of the main stack. There would be fins located vertically on the outer surface of the stack to enable the air to be heated while it circulates and thus enhances the heat transfer rate. The retrofit would be like a jacket put on the lower portion of the chimney.

In some factories, the temperature of the flue gas was so high that it could be further used to dry the job before being galvanized. Such a scheme is depicted in Figure 3.3 too where it goes through the drying bed and eliminates the need for fuel towards this purpose.

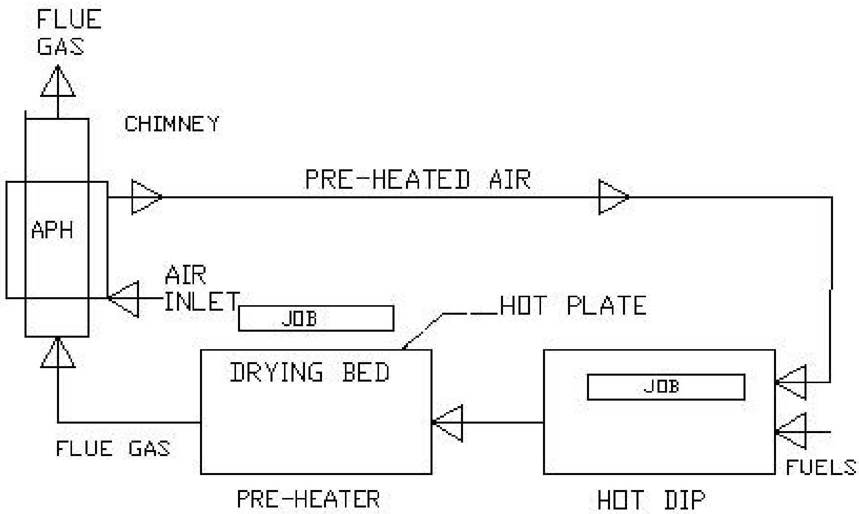

Figure 3.3: Suggested multiple use of the flue gas in a Galvanizing Unit

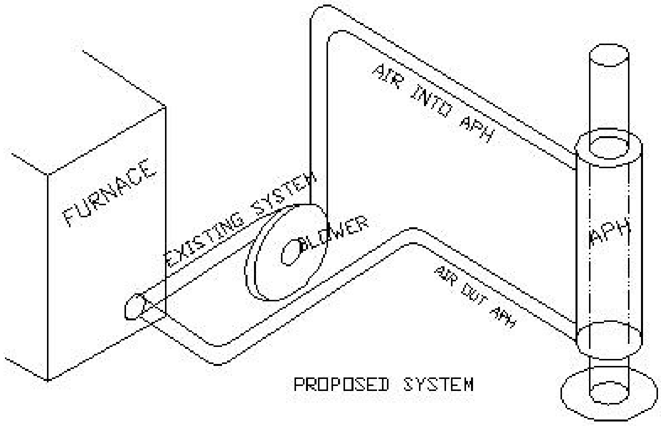

Figure 3.2: Design of the suggested Air Pre-Heater

Financials

Table 3.4: Cost and Benefit details for using this measure and simultaneously replacing the coal fired drying bed

Description	Typical FO Fired		Typical Coal Fired	
	Value	Units	Value	Units
Annual FO/coal consumption	729408	₹/yr	600000	₹/yr
Temperature of the flue gas	536	deg C	433	deg C
The flue gas would be let out at	250	deg C	250	deg C
Assuming that every 23 deg C drop in temperature helps improve efficiency by 1%				
Savings	90700	₹/yr	47739	₹/yr
Probable investment				
fabricating heat exchanger	30000	₹	30000	₹
steel piping	10000	₹	10000	₹
lagging	10000	₹	10000	₹
Oxygen sensor and blower motor	100000	₹	100000	₹
Total investment	150000	₹	150000	₹
Estimated life of system	10	yrs	10	yrs
Depreciation	15000	₹/yr	15000	₹/yr
Simple payback	20	months	38	months
ROI	50%		22%	