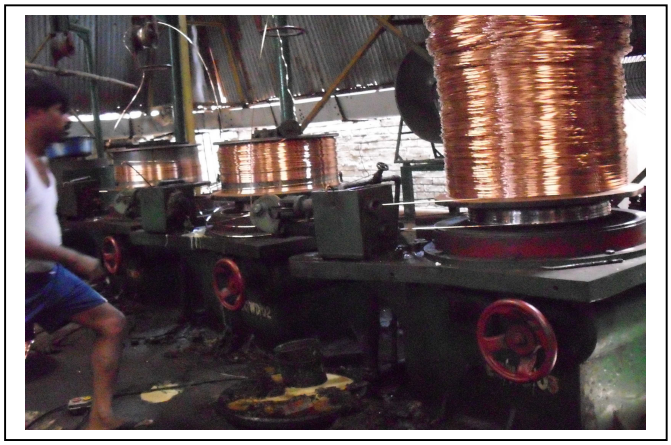
MANUAL ON ENERGY CONSERVATION MEASURES IN GALVANIZING & WIRE - DRAWING SECTOR HOWRAH CLUSTER



ENERGY IS LIFE
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Abbreviations and Units:

APH	Air Pre-heater
BEE	Bureau of Energy Efficiency
DPR	Detailed Project Report
ECM	Energy Consumption Measures
EE	Energy Efficiency
EEM	Energy Efficiency Measures
FO	Furnace Oil
GCV	Gross Calorific Value
GOI	Government of India
GHG	Green House Gases
hp	Horse Power
kCal	Kilo Calorie
kg	Kilo Gram
kJ	Kilo Joule
kW	Kilo Watt
kWh	Kilo Watt Hour
l	Litre
LSP	Local Service Provider
MS	Mild Steel
MSME	Micro Small and Medium Enterprises
NA	Not Available
NAp	Not Applicable
SME	Small and Medium Enterprises
T	Ton
TPA	Ton per Annum

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.

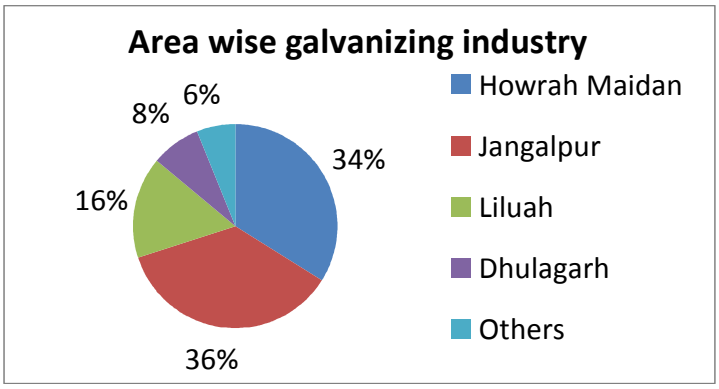

Figure 2.1: Area-wise Classification of Galvanizing Units in Howrah Cluster

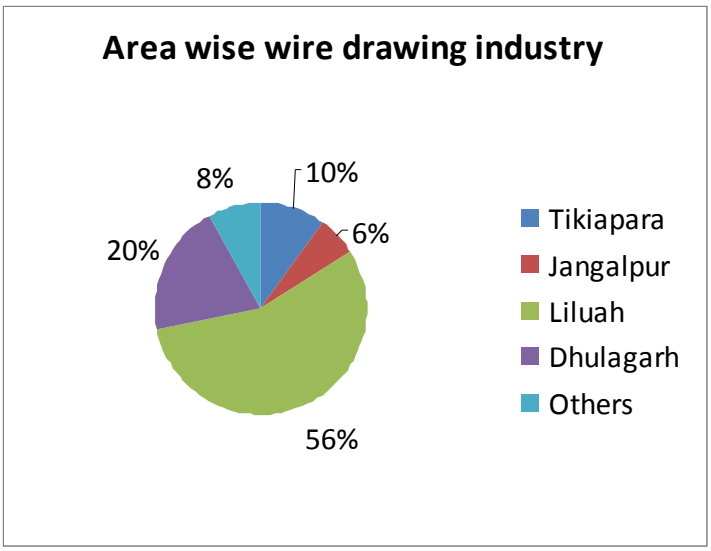

Figure 2.2: Area-wise Classification of Wire-drawing Units in Howrah Cluster

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.).

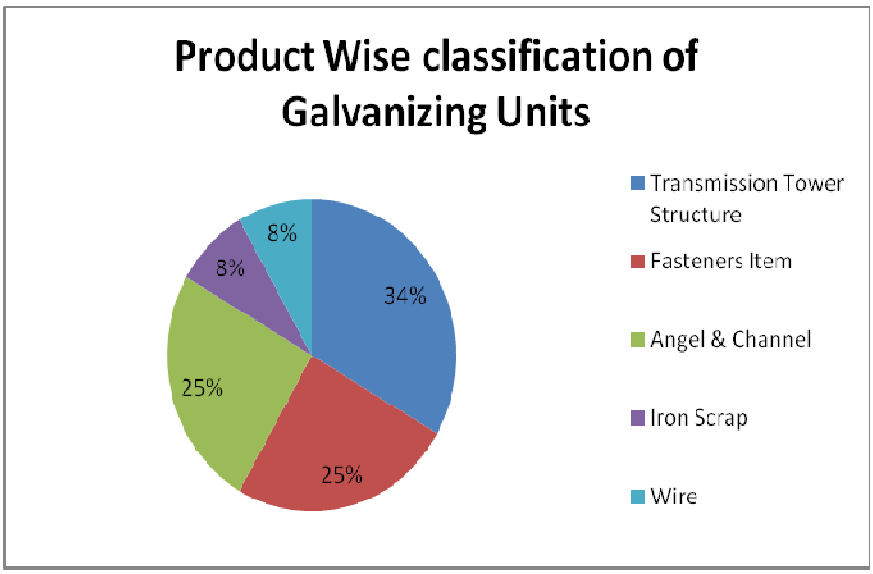

Figure 2.3: Product Wise Classification of Galvanizing Units

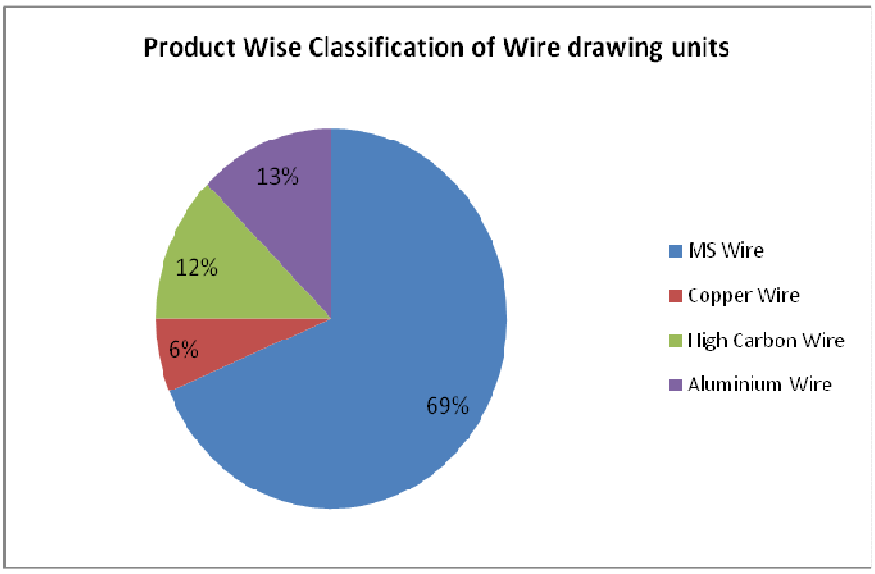

Figure 2.4: Product Wise Classification of Wire-drawing Units

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.

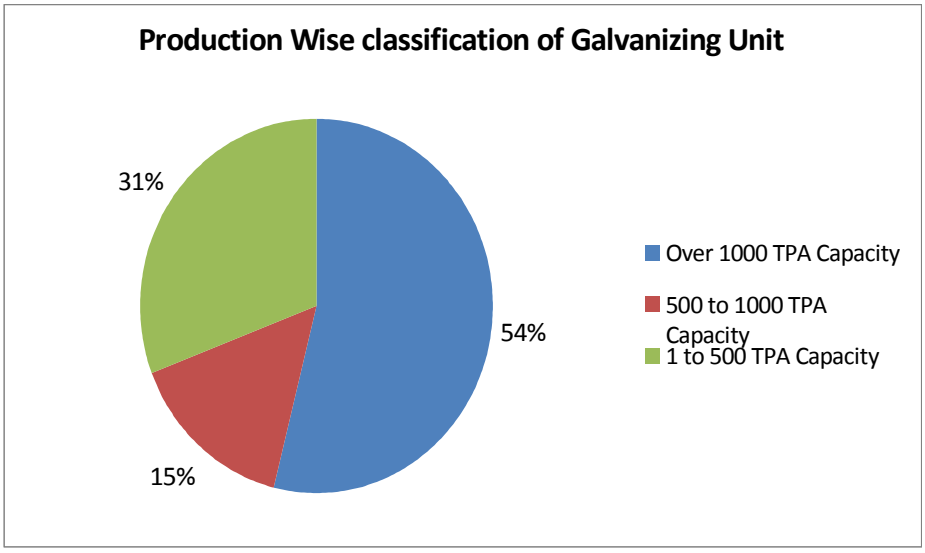

Figure 2.5: Production Wise Classification of Galvanizing Units

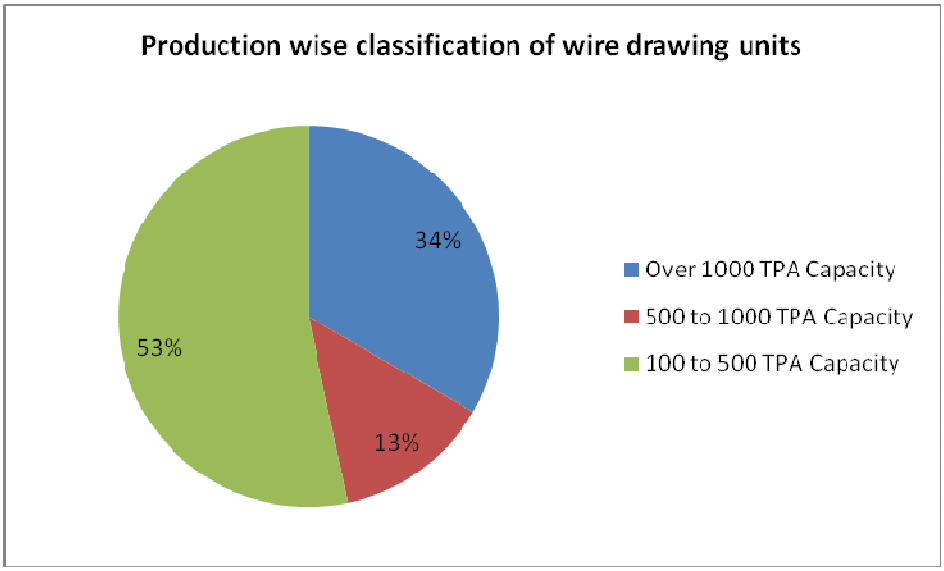

Figure 2.6: Production Wise Classification of Wire-drawing Units

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*

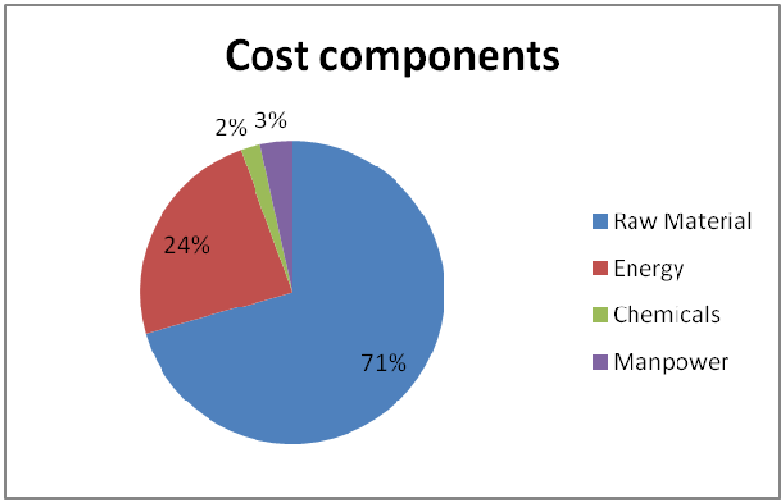

Figure 2.7: Share of Cost Inputs in a Typical Galvanizing Unit

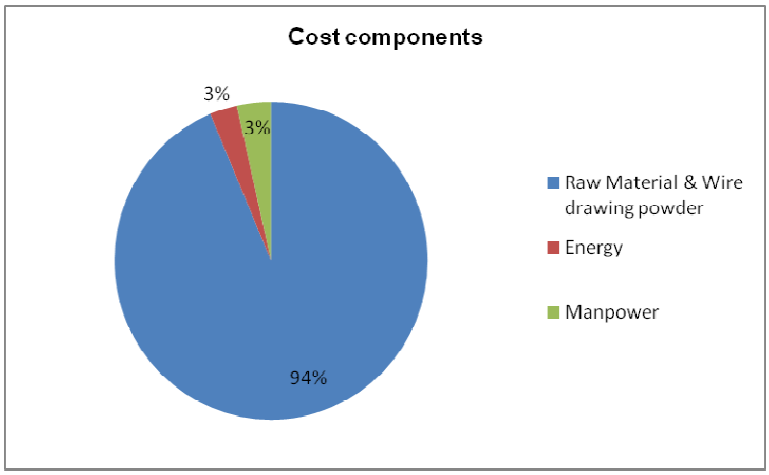

Figure 2.8: Share of Cost Inputs in a Typical Wire-drawing Unit

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.

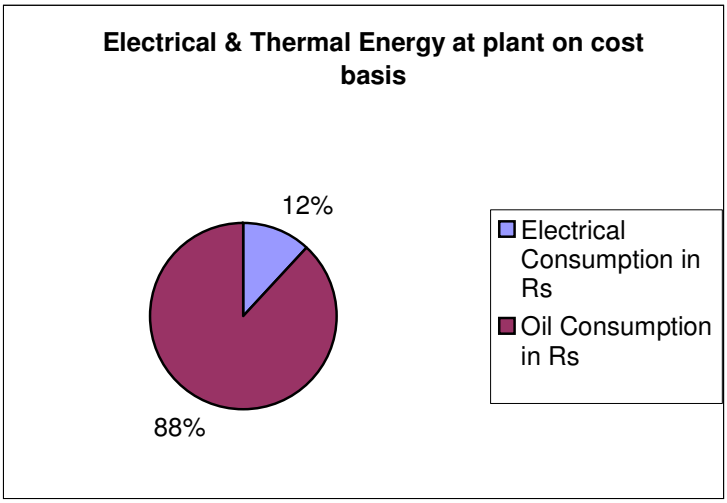

Figure 2.9: Share of Annual Energy Consumption in a typical galvanizing unit

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

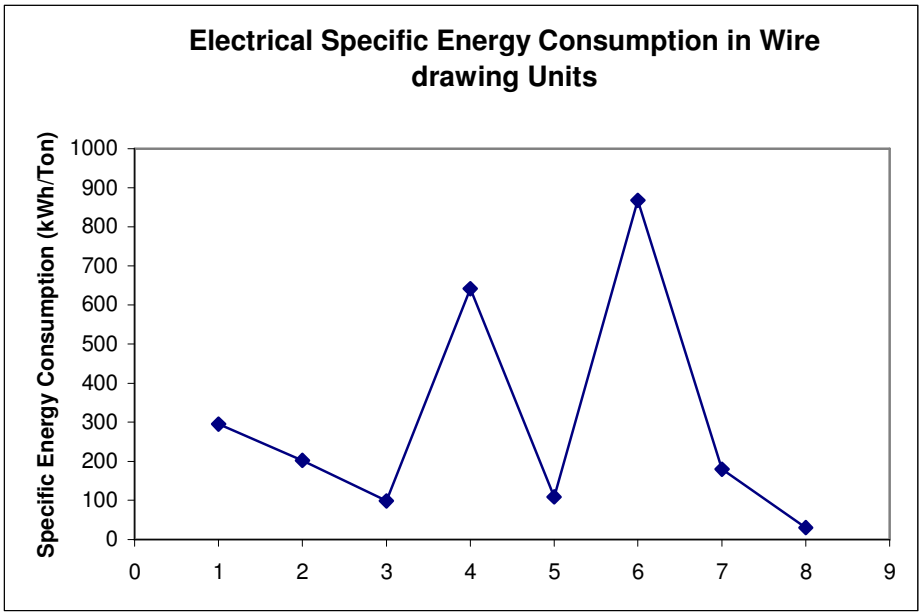

Figure 2.10: Electrical Specific Energy Consumption in Wire drawing Units

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.

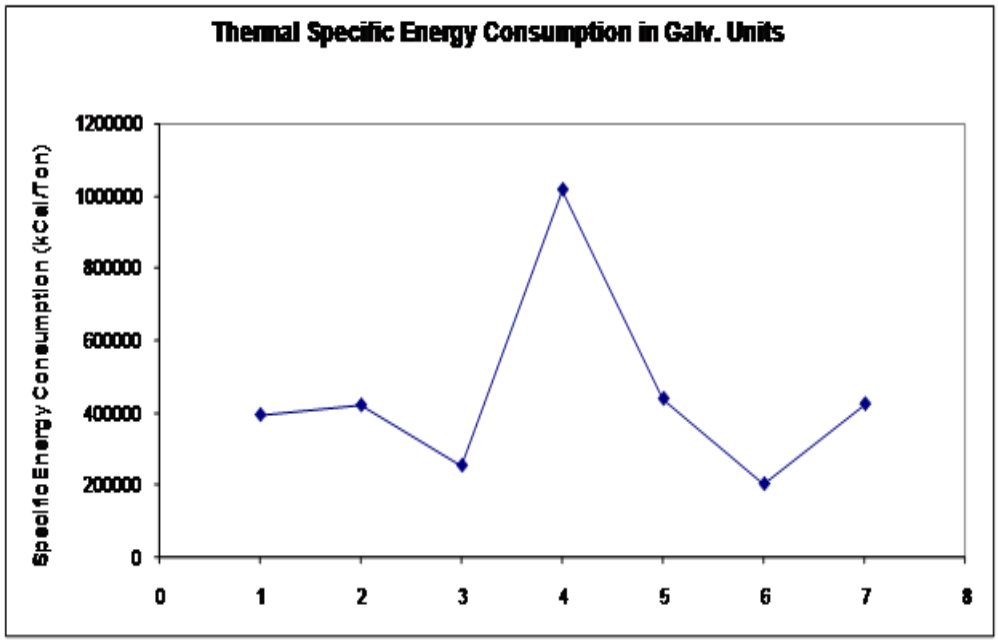

Figure 2.11: Thermal Specific Energy Consumption in Galv. Units

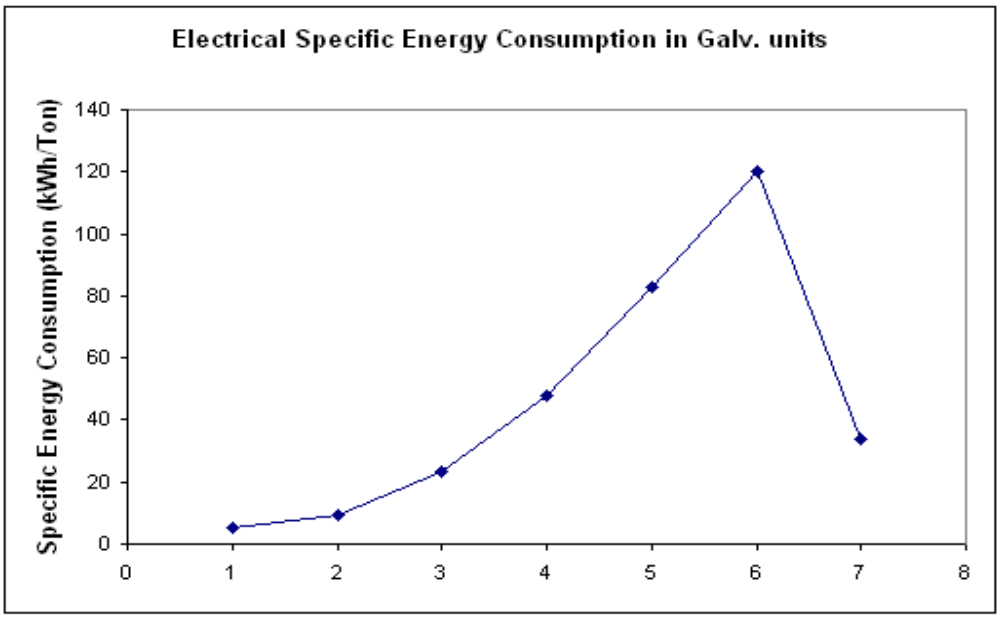

Figure 2.12: Electrical Specific Energy Consumption in Galvanizing units

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

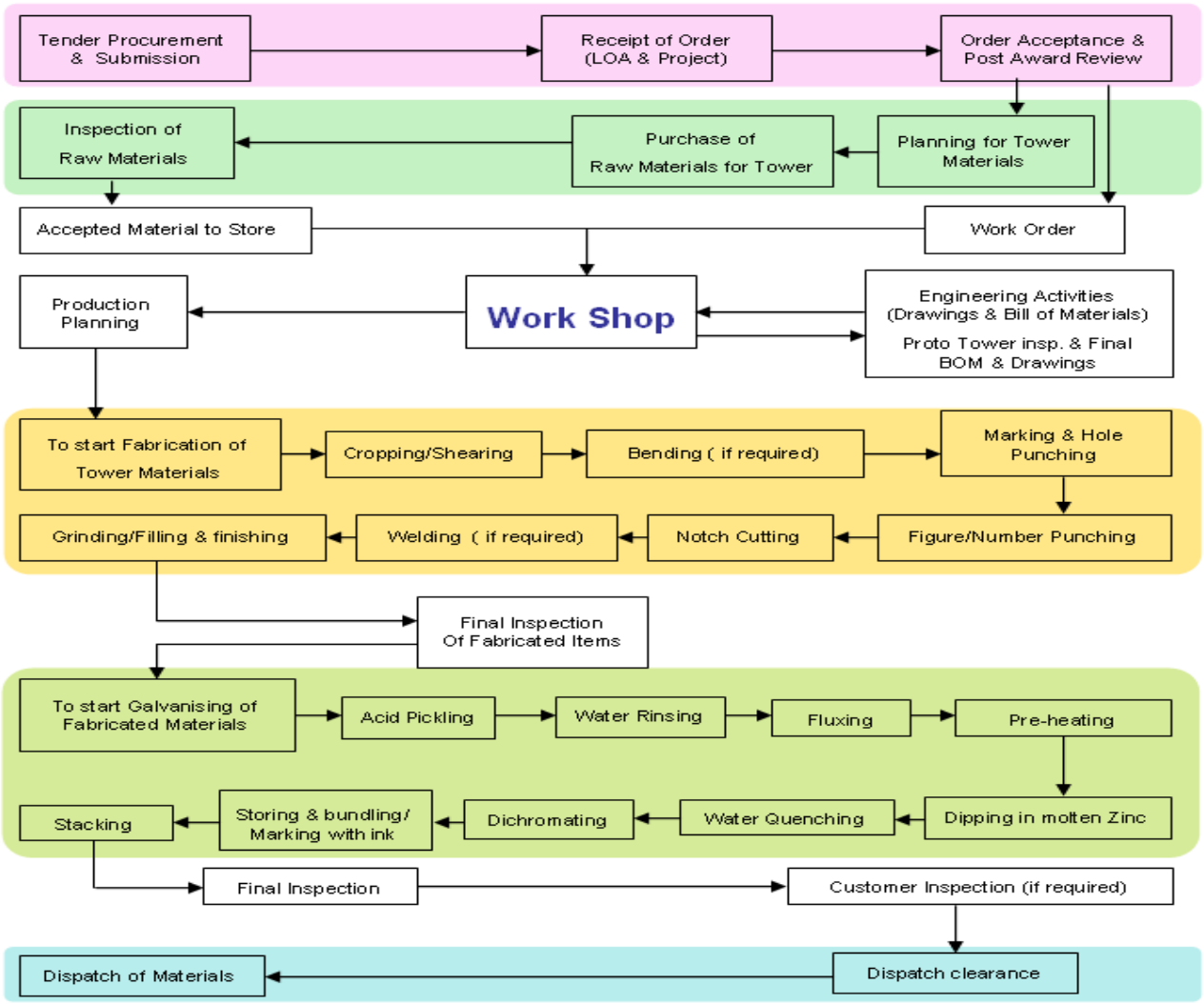

Figure 2.13: Galvanizing Process Flow Chart in a Typical Unit with Fabrication Activity

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.

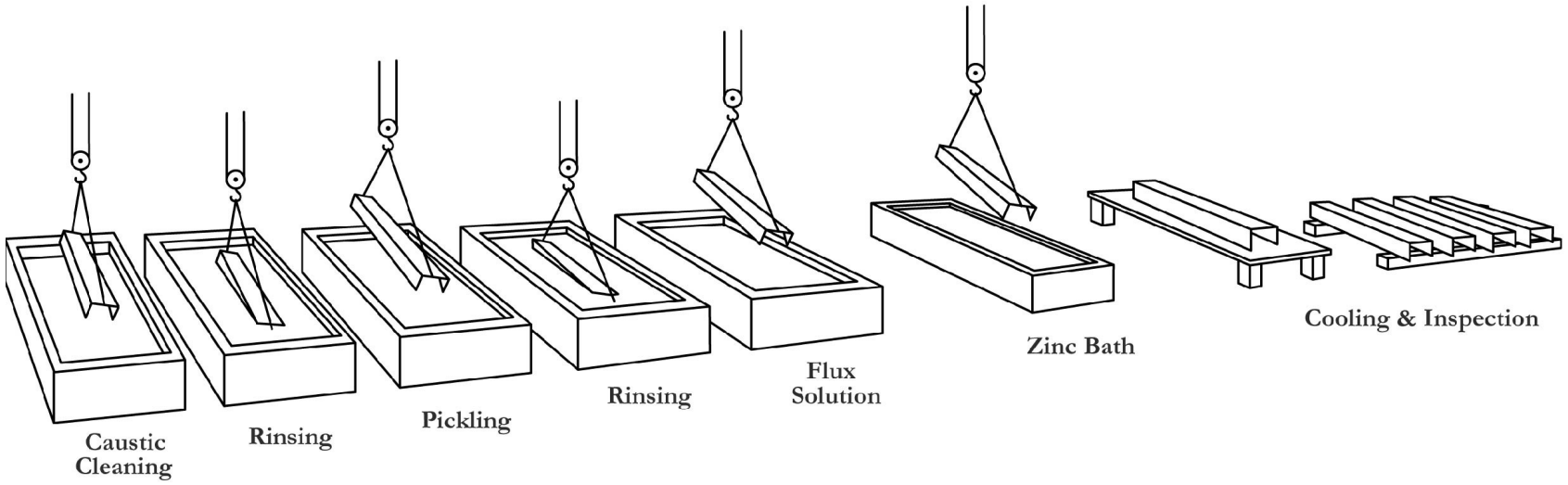

Figure 2.14: Galvanizing Process Flow Chart in a Typical Unit without Fabrication Activity

2.3.2.2 Process Flow Diagram for Wire-drawing Units

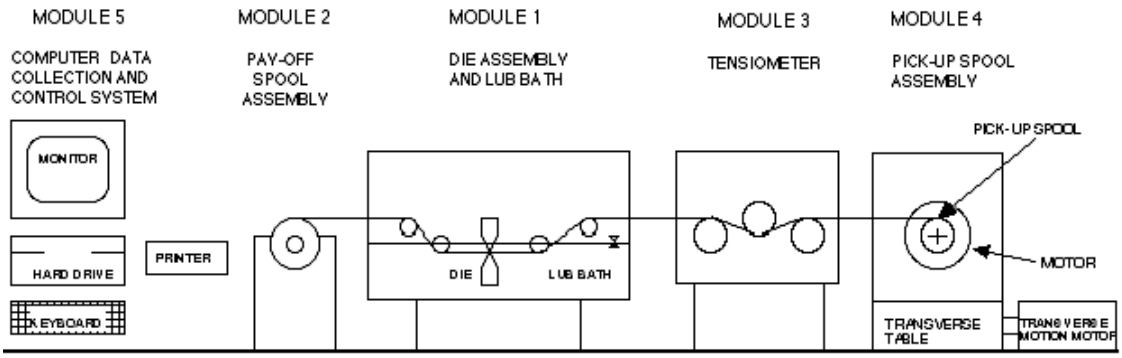

Figure 2.15: Schematic of a Typical Wire-drawing Bench

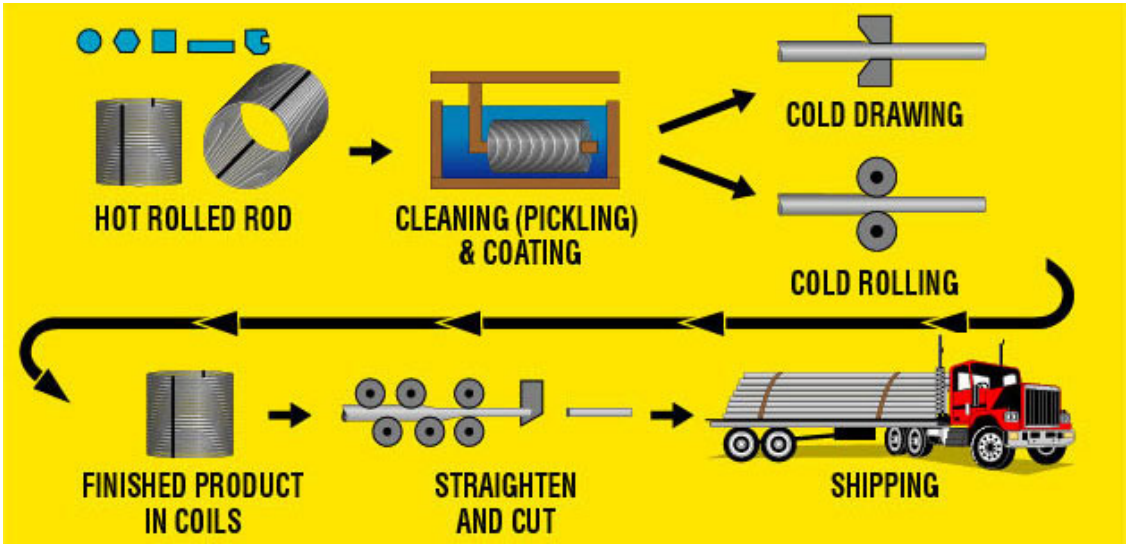

Figure 2.16: Wire-drawing Process Flow Chart in a Typical Unit

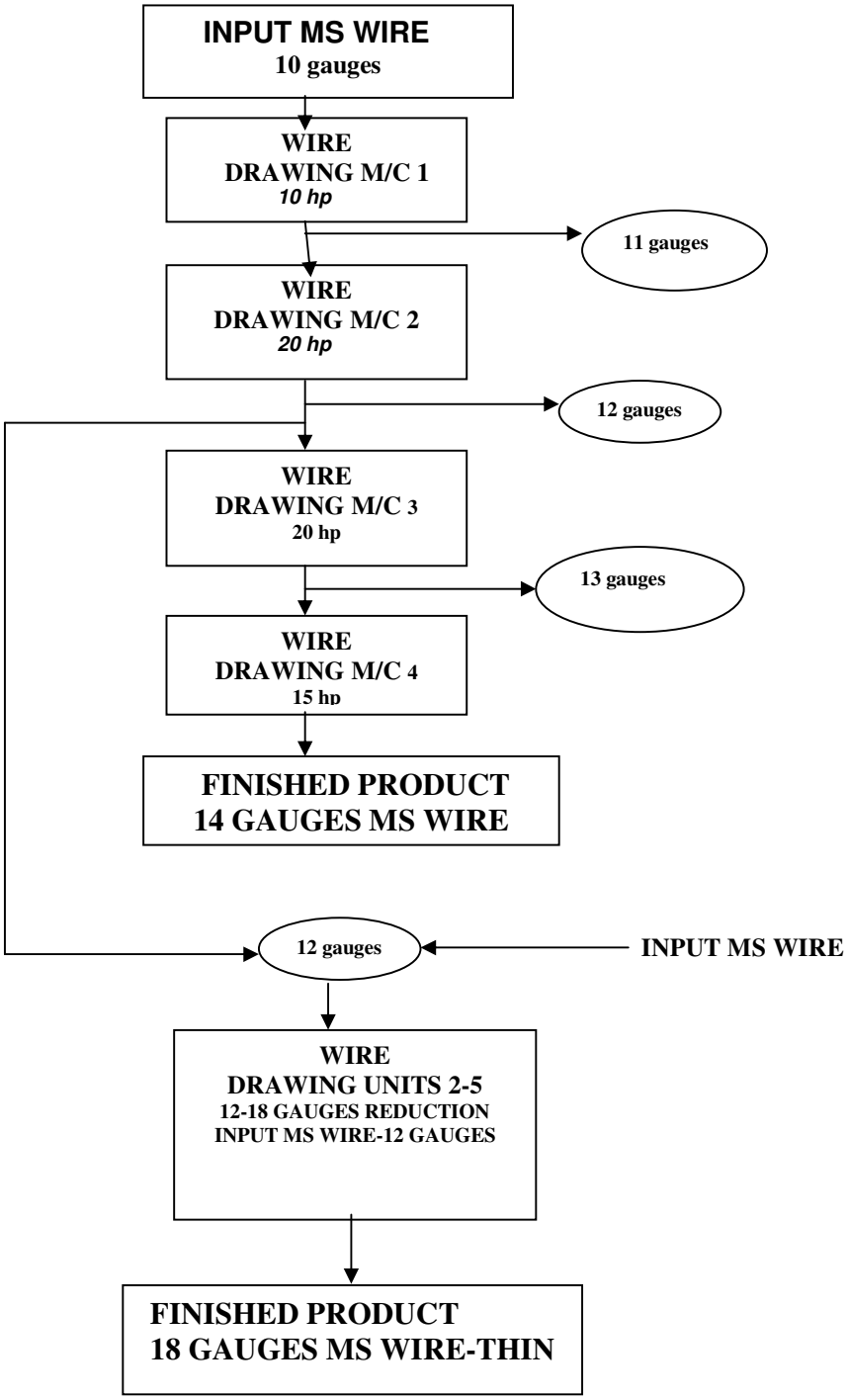

Figure 2.17: Wire-drawing Process Flow Chart in a Typical Unit without Annealing

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

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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.

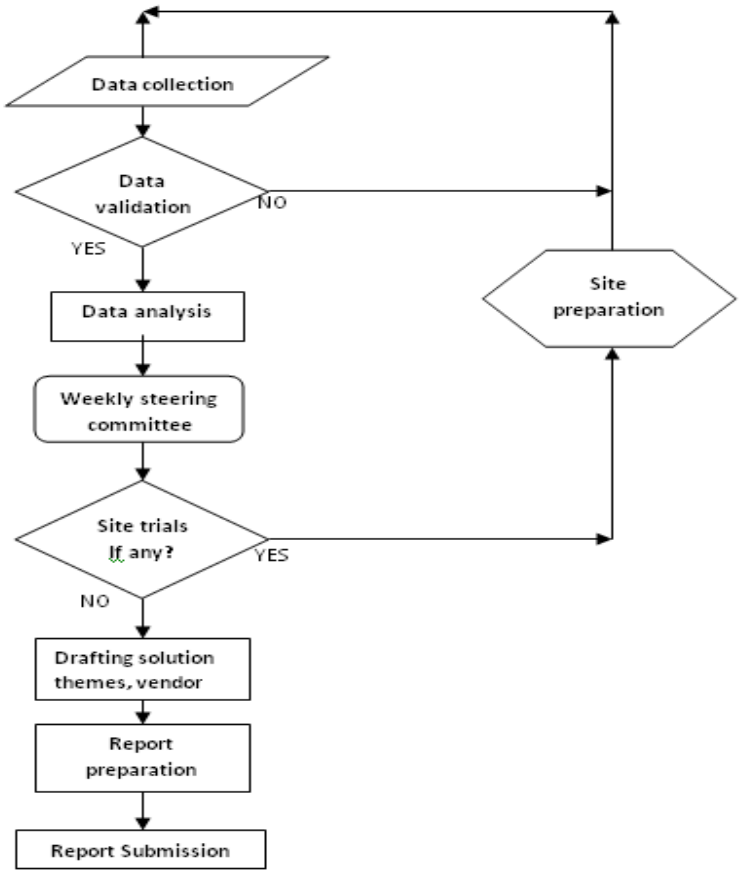


Figure 3.1: Audit Methodology

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 out-

dated 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 ^{o}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 ^{o}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.

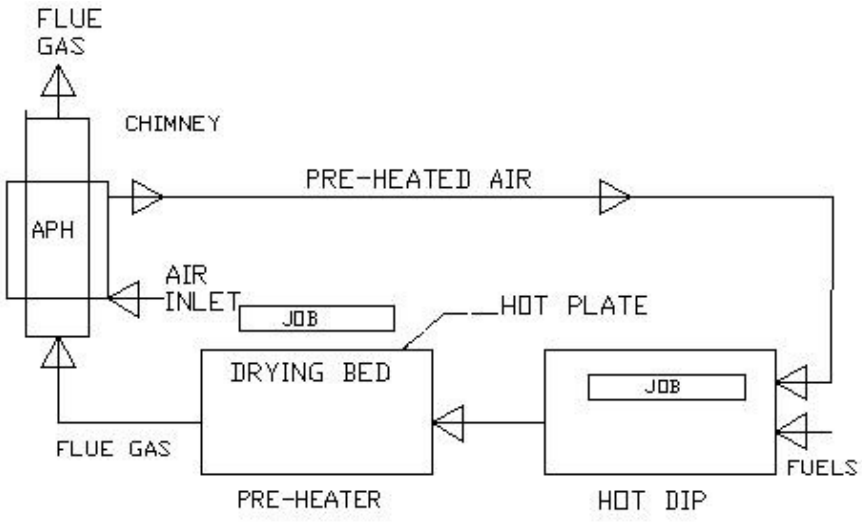


Figure 3.3: Suggested multiple use of the flue gas in a Galvanizing Unit

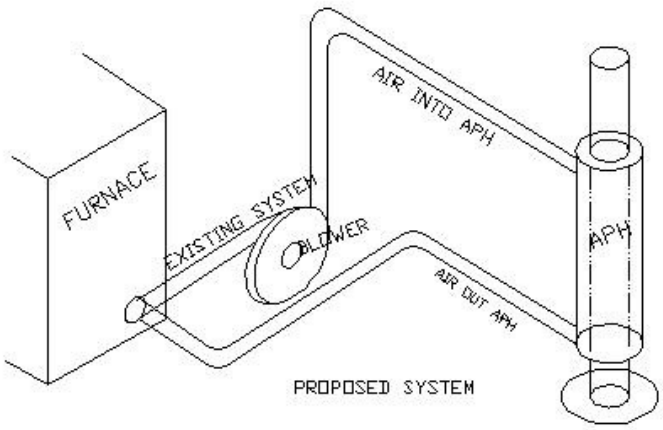


Figure 3.2: Design of the suggested Air Pre-Heater

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%	

Possible drawbacks toward implementation

There could be hindrances like lack of information within the management. They may not be aware that this option saves a lot of money in the long run and look at it more sceptically since it is not a conventionally used approach.

2) **ECM – 2 : Waste heat recovery from flue gas for boiling the flux solution before being galvanized**

Background

In some of the factories, it was found that the flue gas was hot enough to be used further even after being used to heat the combustion air. The present system did not even attempt to use the heat. The flue gas at this point (i.e. after APH) would be which is currently done by burning fossil fuels found to be in the range of 200 to 300 ^{o}C and hence the thermal energy is wasted. This heat in the spent gas could be recovered and used to boil the flux solution.

Description and benefits of implementation

Thus a suggestion was made to utilize it in boiling the flux solution as well (required for cleaning the job to be galvanized and consumed fuel). Here, the suggested measure was to direct the flue gas through a channel in the ground which went under the container that contained the flux solution. The design was such that it created vortices in the flue gas as it went under the container, thereby having a better heat transfer coefficient. This particular design was from the IISWBM team was appreciated by one of the companies and has already been implemented. The results are being awaited. After implementation of the suggested measure the fuel consumption for pre-heating the flux solution could be totally stopped.

Financials

Table 3.5: A typical cost and benefit analysis of using this measure

Particulars	Values	Unit
Diesel consumed in a year	19200	l/yr
Cost of diesel	37	₹/l
Saving of diesel oil	710400	₹/yr
Cost of fabricating the boiling apparatus	25000	₹
lifetime	10	yrs
depreciation	2500	₹/yr
simple payback	1	months
ROI	2832%	

Possible drawbacks toward implementation

There could be hindrances like lack of information within the management. They may not be aware that this option saves a lot of money in the long run and look at it more sceptically.

3) **ECM – 3 : Installation of Air-fuel Controller to Optimize the Excess Air**

Background

To obtain complete combustion of fuel with the minimum amount of air, it is necessary to control air infiltration, maintain pressure of combustion air, fuel quality and excess air monitoring. Higher excess air will reduce flame temperature, furnace temperature and heating rate resulting in need of higher fuel consumption. On the other hand, if the excess air is less, then the un-burnt components in the flue gas will increase and would be carried away through the stack. The recommended excess air needed for complete combustion of furnace oil is around 15%.

Description and benefits of implementation

The optimization of combustion air is the most attractive and economical measure for energy conservation. The impact of this measure is higher when the temperature of furnace is high. Air ratio is the value that is given by dividing the actual air amount by the theoretical

combustion air amount and it represents the extent of excess of air. The furnace has to be equipped with an automatic air/fuel ratio controller, it is necessary to periodically sample gas in the furnace and measure its oxygen contents by a gas analyzer. The Figure 3.2 below shows a typical example of a furnace equipped with an automatic air/fuel ratio controller.

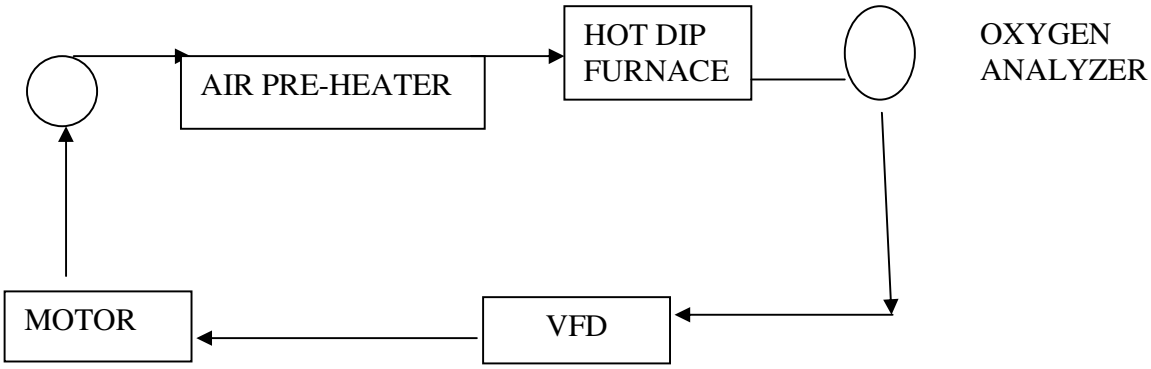


Figure 3.4: Diagram of automatic air/ fuel controller

Financials

Table 3.6: Cost and benefit analysis of using this measure

Particulars	Values	Unit
Air flow based on velocity measurement	1297	m3/hr
Mass Flow Rate	1452	Kg/hr
Flue gas mass flow rate (using anemometer)	1481	Kg/hr
Measured oxygen %	11	%
Excess air	110	Kg/hr
Actual air flow	898	Kg/hr
Flue gas mass flow rate (flue gas analysis)	926	Kg/hr
Difference between air flow values calculated flue gas analysis and blower calculations is	38.16%	
Therefore we take the average of the two flow rates		
Total Air Flow to Furnace	1204	Kg/hr

Particulars	Values	Unit
Oil Consumption Rate	28.5	Kg/hr
Air fuel ratio for FO	15	
Stoiciometric Air Flow Rate	427	(kg/hr)
Actual excess air %	181	%
Considering 15% excess Air (Desired Air)	491	kg/hr
Excess Air % of Desired Air	144	%
Temp of Flue Gas at Outlet	490	deg C
Ambient Temp	40	deg C
Heat Loss	66878	kCal/hr
Equivalent Oil Rate	6.92	l/hr
Working Days per Year	240	days
Savings Potential	19939	l/year
Cost of Oil	30	₹/l
Savings Potential	598170	₹ / year
Probable Investment for VFD Unit Rating = 15 HP/11.25 kW		
Cost of 11.25 kW VFD	47000	₹
Oxygen Sensor and Drive Panel Cost	42000	₹
Total	89000	₹
Purchase Price (PP) including VAT @ 12.5 %	100125	₹
Installation + Commissioning Cost	5000	₹
Total Investment	105125	₹
Payback Period in months	2.10	months
Estimated Life of VFD Unit	8	yrs
ROI	556	%/yr

Possible drawbacks toward implementation

There could be hindrances like lack of information within the management. They may not be aware that this option saves a lot of money in the long run and look at it more sceptically. The measure also involves investment in the excess of 1 lakh rupees which may be cause of concern for the management. However, the payback is low enough for this measure to be an attractive option.

4) **ECM – 4: Improving the insulation on furnaces to bring outside surface temperatures down to 60 deg C.**

Background

Many of the walls of the furnaces used in the sector have temperatures higher than 80 ^{o}C. With the present insulation available, this temperature can be brought down to around 60 ^{o}C. The higher the surface temperature, the higher would be the heat loss from the furnace and hence the higher fuel consumption rate. An economic thickness of insulation would restrict such loss by keeping the surface temperature within a safe value of around 60 ^{o}C.

Description and benefits

The present insulation tiles can contribute to significant savings for the factory since the new ceramic insulation blocks of 1 m^2 area and thickness of 5 mm costs only about ₹ 500. Thus it has been recommended in all cases wherever the outside temperature of the furnace wall was high.

Financials

Table 3.7: Cost and Benefit analysis of using this measure

OIL FIRED HOT DIP ANNEALING FURNACE		
Length	13716	mm
Breadth	3048	mm
Height	1981.2	mm
Average FO consumption	78.6	l/hr
Ambient Temperature around furnace	40	deg C
Cost of Insulation (@₹ 500/m2)	500	

Table 3.8: Heat Loss through furnace side walls (Method 2) [Ref. BEE Book 4, Chapter 2 Page 37-38]

Particulars	Present	with Better Insulation	Unit
North Wall			
T avg	86	60	Deg C
Heat loss rate per unit area at 86 deg C	800	300	kcal/m^2/hr)
Area of furnace wall (north side)	6.04	6.04	m^2
Heat Loss rate	4830	1811	kcal/hr
Calorific Value of Oil	10500	10500	kcal/kg
Equivalent oil loss	0.50	0.19	(lt/hr)
Savings with better insulation		76815	(₹/yr)
Necessary investment for better insulation @ ₹ 500/m2		3019	₹
Payback Period		0.47	months
Similarly for East Wall at	145	60	Deg C
Equivalent oil loss	5.06	0.84	lt/hr
Savings with better insulation		1037005	₹/yr
Necessary investment for better insulation @ ₹ 500/m2		13587	₹
Payback Period		0.16	months
Similarly for West Wall at	175	60	Deg C
Equivalent oil loss	6.19	0.84	lt/hr
Savings with better insulation		1313540	(₹/yr)
Necessary investment for better insulation @ ₹ 500/m2		13587	₹
Payback Period		0.12	months

Particulars	Present	with Better Insulation	Unit
Similarly for South Wall at	85	60	
Equivalent oil loss	0.31	0.19	lt/hr)
Savings with better insulation		29189	(₹/yr)
Necessary investment for better insulation @ ₹ 500/m2		3019	(₹)
Payback Period		1.24	months
Similarly for Top Surface at	70	60	Deg C
Savings with better insulation		127631	(₹/yr
Necessary investment for better insulation @ Rs.500/m2		20903	₹
Payback Period		1.97	months
Total heat loss of fuel oil	13.9		l/hr
Specific Gravity of Oil	0.92		
Total loss of fuel oil	12.8		kg/hr
Total Percentage loss	17.6		%
Savings with better insulation (₹/yr) with pay-back-period < 2 yrs)		**2584183**	₹
Necessary investment for better insulation @ ₹500/m2		**54116**	₹
Payback Period		0.3	months
Assumed Life of Insulation		4	yrs
ROI		**4750**	**%/yr**

Possible drawbacks toward implementation

There could be hindrances like lack of information within the management. They may not be aware that this option saves a lot of money in the long run and look at it more sceptically.

5) ECM – 5 : Usage of Soft Starters cum Energy Saver to Prevent High Currents during Starts

Background

Typically most AC motors are under full load only for a few seconds at initial startup. The motor itself has no way of adjusting the amount of electricity it draws in relation to the load required by the system. For most of the time therefore the motor will draw excess electricity that is burned off principally as heat.

Description and benefits

Energy Saver is an intelligent power controller for single and three phase electric motors that regulates the line voltage to the motor. When running loads are low, the motor torque requirement is less than specification, so motor voltage can be reduced. Such reduction leads to a decrease in the motor losses and so to an improvement in energy efficiency.

The unit monitors the load at the motor and accordingly optimizes the voltage, current and power factor thereby reducing the running cost of the electric motor. The energy saving is typically between 10-40%. The system will be paying back for itself entirely out of the savings it generates within 6-24 months depending on level of savings and power tariff. In the present study, we found a conservative 10% savings potential is applicable.

The soft starter facility provides a gradual and controlled increase in the voltage applied to the motor terminals, thus eliminating the high peak current created during the starting cycle of Induction motors. The energy saver constantly adjusts the voltage to the terminals of the motor to that which is just sufficient to meet the load on the motor. It is able to detect any change in a varying load by help of microprocessor control and adjust the voltage output accordingly. By matching the output to load, the losses inherent in all AC motors are considerably reduced thereby dramatically improving the motor efficiency and reducing running costs.

Table 3.9: Name of the LT Motors with DOL Starting Where Energy Saver cum Soft Starter can be installed

		Rated		Measured							
Sl No	Motor Name	HP	kW	kW	% Loading	Savings in ₹	Investment in ₹	Payback Period in months	Esti-mated Life in years	Deprec-iation Charges (₹)	ROI %/ yr
1	Wire Drawing m/c 1-Motor 1-Unit 1	25	18.75	18.77	100%	56896	42500	8.96	8	5313	121
2	Wire Drawing m/c 2-Motor 2-Unit 1	25	18.75	14.25	76%	43195	25000	6.95	8	3125	160
3	Wire Drawing m/c 3-Motor 3-Unit 1	20	15	14.43	96%	43740	25000	6.86	8	3125	162
	Total					**143830**	**92500**	**7.72**		**11563**	**143**

Drawbacks in implementation

The management is usually not aware that such a device exists and can help in getting monetary benefits. They can be made more aware of the situation to help the case for using this measure.

6) **ECM-6: Using maximum demand controllers to shut down some machines when the ceiling of contract demand is crossed**

Background

Some of the units suffer penalty for exceeding contract demand for almost every month. Their average load factor being much less (< 50%). A study revealed that if informed properly they can control the operation of the equipments without hampering the production process. Maximum demand controller can provide the facility to control major loads such that the maximum demand does not exceed the contract demand for more than 15 minutes at a stretch which is the maximum allowable time by the utility for such act.

Benefits

These are suitable cases for employment of maximum demand controller which would reduce the load as soon as it finds the demand exceeding the contract demand. It would turn off say some of the less important motors or devices and reduce load.

Financials

Table 3.10: Cost and benefit analysis of using this measure

Investment	Amount	Unit	Electricity Bill per month	Difference Due to Penalty for Exceeding Contract Demand
			₹	₹
Device	25000	₹	158959	
installation and wiring	25000	₹	207456	5700
Total	50000	₹	175545	11760
Saving	100000	₹	181945	5280
Payback	0.5	yrs	179851	330
Lifetime	10	yrs	195567	25410
Depreciation	5000	₹/yr	196615	17820
ROI	190%		286250	23760
			208701	2970
			233415	14190
			219077	14520
			244494	20130
		TOTAL	**2487875**	**141870**

Total electricity bill is 2487875 ₹/yr. Due to penalty for exceeding contract demand is 141870 ₹/yr. By conservation estimate, we are assuming at least ₹ 100000 savings by maximum demand controller.

Drawbacks in implementation

The management may be oblivious of the amount of savings such a measure can provide and may not agree to implement it since it is not one of the conventional options.

7) **ECM-7: Replacing Present Motors with Energy Efficient motors to Improve Efficiency**

Background

Energy-efficient motors (EEM) of EFF1 type are the better ones in which, design improvements are incorporated specifically to increase operating efficiency over motors

of standard design (see Figure 3.5). Design improvements focus on reducing intrinsic motor losses. Improvements include the use of lower-loss silicon steel, a longer core (to increase active material), thicker wires (to reduce resistance), thinner laminations, smaller air gap between stator and rotor, copper instead of aluminum bars in the rotor, superior bearings and a smaller fan, etc.

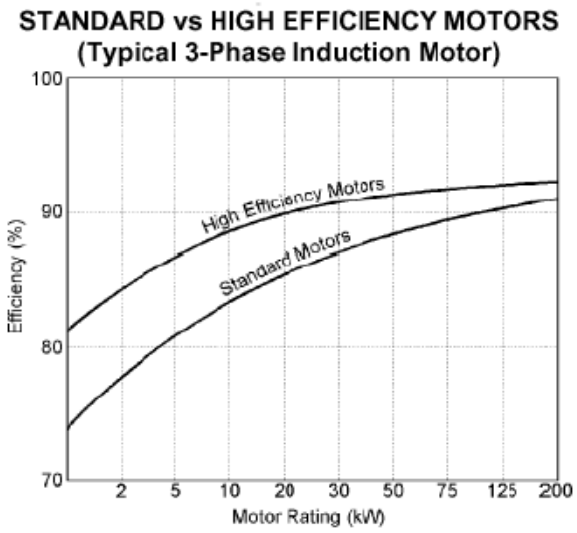


Figure 3.5: Comparison of High Efficiency Motors with Standard Motor

Description and Benefits

Energy-efficient motors now available in India operate with efficiencies that are typically 3 to 4 percentage points higher than standard motors. in keeping with the stipulation of the BIS, energy-efficient motors are designed to operate without loss in efficiency at loads between 75 % and 100 % of rated capacity. This may result in major benefits in varying load applications. The power factor is about the same or may be higher than for standard motors. Furthermore, energy-efficient motors have lower operating temperatures and noise levels, greater ability to accelerate higher-inertia loads, and are less affected by supply voltage fluctuations.

Financials

Table 3.11: Cost and benefit analysis in using above measure

	Motor Name	Hydraulic press motor	Power press motor 1	Power press motor 2	Power press motor 3	Total
RATED	kW	5	15	7.5	7.5	
MEASURED	Amp	4.43	3.6	7.52	3.86	
	Voltage	407	273	400	407	
	PF	0.13	0.34	0.22	0.44	
	kW	0.33	0.60	0.90	1.25	
% of Loading		6.5	4	12	16.7	
Present Efficiency	%	10	10	10	10	
Suggested Motor Rating	(kW)	0.55	0.75	1.1	1.5	
Cost (EFF1 and cyclic load energy saver)	(₹)	17636	17623	19138	20164	74561
Proposed efficiency	%	95	95	95	95	
proposed input to EEM	kW	0.03	0.06	0.10	0.13	
Reduction in operating power	kW	0.29	0.54	0.80	1.12	
Hours per year		3600	3600	3600	3600	
Energy savings by EFF1	kWh/yr	971	1793	2689	3735	
Energy savings by cyclic load energy	kWh/yr	13	23	35	NA	

	Motor Name	Hydraulic press motor	Power press motor 1	Power press motor 2	Power press motor 3	Total
saver						
Total energy savings	kWh/yr	984	1816	2724	3735	
Cost of electricity	₹/kWh	5.35	5.35	5.35	5.35	
Savings	₹/yr	5263	9716	14574	19982	49534
Pay Back	Yrs	3.11	1.58	1.28	0.88	1.37
Estimated Life	Yrs	15	15	15	15	15
Depren. Charges.	₹/Yr	1092	1025	1246	1172	4534
ROI	%/Yr	25.5%	56.6%	71%	107%	66%

Drawbacks to implementation

Many of the companies say that the present motors are well within their lifetimes and hence are reluctant to invest in newer ones even though those are more efficient. They have to be explained how substantial the savings could be.

3.6. Energy conservation measures for the wire-drawing industry

1) ECM-1: Usage of Air Pre-heater to Recapture Heat from the Flue Gas and warm the combustion air

Background

Some of the wires drawing units have furnaces for either annealing or melting metal. The flue gas from such furnaces were found to be simply let out and hence wasted. This heat in the spent gas could be recycled and used to pre-heat the combustion air.

Benefits

The IISWBM team designed an Air Pre-Heater for the purpose and is shown in the Figure 3.6. In this design, the air to be heated is put in a cylindrical chamber on the outer side of the main stack. There would 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. This could raise the temperature of the combustion air by even 200 °C.

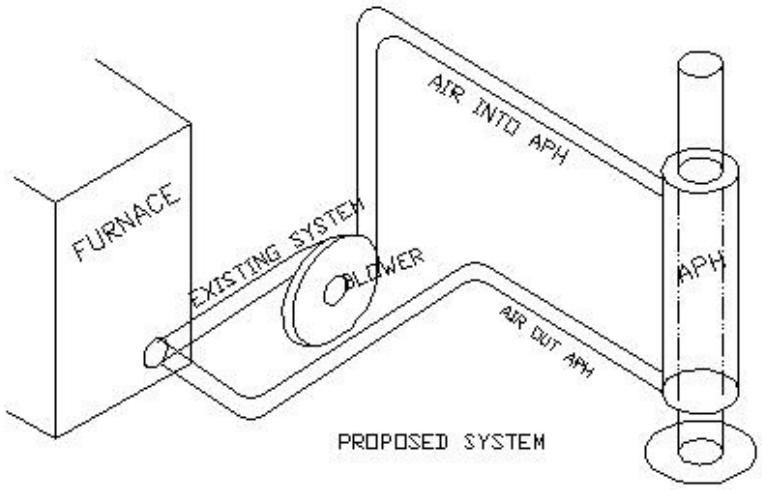


Figure 3.6: Design of the suggested Air Pre-Heater

Financials

Sample cost and benefit analyses have been attached in ECM1 of the galvanizing units.

Drawbacks in implementation

The management may be oblivious of the amount of savings such a measure can provide and may not agree to implement it since it is not one of the conventional options.

2) ECM-2: Installation of Air-fuel Controller to Optimize the Excess Air

To obtain complete combustion of fuel with the minimum amount of air, it is necessary to control air infiltration, maintain pressure of combustion air, and fuel quality and excess air monitoring. Higher excess air will reduce flame temperature, furnace temperature and heating rate. on the other hand, if the excess air is less, then the un-burnt components in

the flue gas will increase and would be carried away through the stack. The recommended excess air needed for complete combustion of furnace oil is around 15%.

Benefits

The optimization of combustion air is the most attractive and economical measure for energy conservation. The impact of this measure is higher when the temperature of furnace is high. Air ratio is the value that is given by dividing the actual air amount by the theoretical combustion air amount, and it represents the extent of excess of air.

The furnace has to be equipped with an automatic air/fuel ratio controller, it is necessary to periodically sample gas in the furnace and measure its oxygen contents by a gas analyzer. The Figure 3.7 below shows a typical example of a furnace equipped with an automatic air/fuel ratio controller.

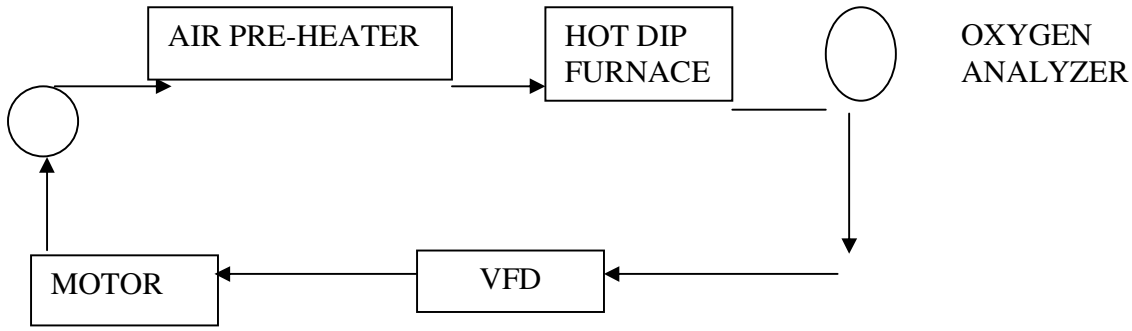


Figure 3.7: Diagram of automatic air/ fuel controller

Drawbacks in implementation

The management may be oblivious of the amount of savings such a measure can provide and may not agree to implement it since it is not one of the conventional options.

3) ECM-3: Replacing Present Motors with Energy Efficient motors to Improve Efficiency:

The same is discussed in the Galvanizing section. The typical case for Wire-drawing Units is placed below:

Table 3.12: Cost and benefit analysis of using reduced size Energy Efficient Motors

Motor Name		Motor 1-Unit 1	Motor 4-Unit 1	Motor 6-Unit 1	Motor 1-Unit 2	Motor 4-Unit 2	Motor 6-Unit 2	Motor 1-Unit 3	Total (for 7 motors)
Rated power	**HP**	10	7.5	7.5	10	7.5	7.5	10	
Rated power	**kW**	7.5	5.6	5.6	7.5	5.6	5.6	7.5	45
Measured power	**kW**	4.0	3.2	2.8	3.0	3.7	4.6	3.8	25
% Loading	**%**	53%	56%	50%	40%	65%	82%	51%	
Present efficiency	**%**	85%	85%	85%	80%	85%	85%	85%	
Proposed Efficiency with EEM	**%**	93%	93%	93%	93%	93%	93%	93%	
Expected Input power with EE motor		3.63	2.90	2.56	2.55	3.35	4.22	3.48	
Reduction in operating power	**kW**	0.34	0.27	0.24	0.42	0.31	0.40	0.33	

Motor Name		Motor 1-Unit 1	Motor 4-Unit 1	Motor 6-Unit 1	Motor 1-Unit 2	Motor 4-Unit 2	Motor 6-Unit 2	Motor 1-Unit 3	Total (for 7 motors)
Recommended size of EE Motor	**kW**	5.5	3.7	3.7	3.7	3.7	5.5	5.5	
Annual operating hours	**hours/yr**	7200	7200	7200	7200	7200	7200	7200	
power savings	**kWh/yr**	2459	1963	1734	2989	2267	2861	2360	
Cost of electricity	**Rs/kWh**	5.04	5.04	5.04	5.04	5.04	5.04	5.04	
Savings	**Rs/yr**	12393	9895	8740	15065	11425	14422	11893	83833
Investment	**Rs**	24838	18042	18042	18042	18042	24838	24838	146682
Payback Period	**yrs**	2	1.82	2.06	1.20	1.58	1.72	2.09	1.75
ROI	**%/yr**	43.2	48.2	41.8	76.8	56.7	51.4	41.2	50.5

4) ECM-4: Replacement of electric furnace with gas fired radiation furnace:

Background

Some companies use electricity for heating their furnaces to achieve better control of temperature. This kind of furnace is having very high running cost as the price of electricity is higher for the same energy input. Recent development in gas firing system helps us to attain finer control of temperature at lower cost of fuel.

Description and benefits

A gas-fired radiation furnace, as shown in attached figure, is better in that regard. Further, some companies sell film-burners for gas-fired furnaces which contribute to the savings by an additional 10%.

Figure3.8: A Typical Gas Fired Furnace

Financials

Table 3.13: Cost and benefit analysis of using this measure

Particulars	Values	Unit
Present rate consumption of electricity in electric furnace	45.4	kW
No of hours operational per day	3	hours/day
Number of days in year	300	days/yr
Electricity consumed	40815	kWh/yr
Cost of electricity unit	8.42	₹/kWh
Cost of electricity	343662	₹/yr
It is proposed to switch over to the gas fired furnace		
Calorific value of 1 kWh of electricity	860	kcal/kWh
Efficiency of gas furnace	0.6	

Particulars	Values	Unit
GCV of LPG gas	15000	kcal/kg
Amount of LPG required to replace electricity	3900	kg/yr
Cost of LPG per kg	32	₹/kg
Cost of LPG	124803	₹/yr
Cost of installation of the gas furnace	450000	₹
Savings per year	218859	₹/yr
Life of the furnace	6	years
Payback	24	months
ROI	32%	

Drawbacks in implementation

The management may be oblivious of the amount of savings such a measure can provide and may not agree to implement it since it is not one of the conventional options. Further, since the present furnace is already operational, they many not want to replace it till it nears it's end of term.

5) ECM-5 Usage of Direct Wire-Drawing Machine

Background

It was noted that a majority of the wire drawing units in the cluster used conventional machines for drawing wires where multiple motors were used to spin the various spools. There were one spool each for every stage of reduction of the cross-section of the wire and attention is required at every stage. Thus the energy consumption is more and so is the maintenance and operational cost requiring more manpower. The newly introduced Direct Wire-drawing machines overcome such barrier by providing a single motor operation and drawing of wire through multiple dies.

Description and benefits

This machine passes the wire through multiple dies in a single draw without making it pass through intermediary spools. Only one motor pulls the entire process and hence

saves power. Further, since the entire process happens in one go, it requires less manpower to look out for slackening of wire.

Financials

Table 3.14: Cost and benefit analysis for a typical Case of Using Straight Wire-Drawing Machine

Particulars	Values	Unit
Investment	750000	₹
rating of motor used	70	hp
	53.2	kW
Savings in energy consumed/yr	79800	kWh/yr
Unit price of electricity	8.42	₹/kWh
Total savings	672285	₹/yr
Payback period	1.1	yr
Life	15	yrs
Depreciation	50000	₹/yr
ROI	83%	

Drawbacks to implementation

The machine requires somewhat high investment. Hence a company which is not doing very well financially may not want to opt for it unless it has provisions of financing. The situation can be helped by enabling them access to loans at good rates for buying such a machine.

6) ECM-6: Replacing DC drive motors by AC drive with VFD control

Background

Some of the motors in the especially the Wire Drawing sector are still DC motors. These convert AC into DC first and then use the DC to run the machine. Thus this machine has an overall efficiency lower than 80%.

Benefits

AC motors could be directly used to run the machines and have efficiencies of the order of 88% (when energy efficiency motors with VFD's are used).

Financials

Table 3.15: Cost and benefit analysis

Particulars	Values	Unit
Rating of the DC motor present	160	kW
Investment	800000	Rs
Power savings by using AC machine	16	kW
Time operational	3000	hrs/yr
Energy savings	48000	kWh/yr
Cost of electricity	8.42	Rs/kWh
Monetary savings/yr	404382	Rs/yr
Payback	1.98	yrs
Life of the machine	8	yrs
Depreciation cost	100000	Rs/yr
ROI	38%	

Drawbacks in implementation

Larger scale machines with high power are rather expensive. The units may not want to change such machines to newer ones. Further, certain types of wire drawing machine are not available in the AC type from common manufacturers. The DC machines may have to be locally adapted to get the AC machines and does not have any manufacturer guarantee. Companies may thus be reluctant to use these.

3.7. Availability of Technology Suppliers/Local Service Providers For Identified Energy Conservation Proposals

Technology suppliers/local service providers are identified for all major energy saving proposals discussed in above sections. Majority of the local service providers are in cluster.

Details of the identified technology supplier/local service providers in Galvanizing & Wire-drawing Howrah cluster are furnished in Annexure-2 and same is attached along with this report.

3.8. Identification of Technologies/Equipments for DPR Preparation

Criteria for identification of technologies/equipment for DPR preparation are as placed below:

- Scale of impact in terms of energy and monetary savings as well as GHG emission reduction.
- Replicability of the case in other units in the sector both inside as well as outside the cluster.
- Long term impact of the same particularly in terms of sustainability of the sector.
- Bankability of the proposal.

Based on the study conducted by IISWBM, findings during visit by the BEE Experts and subsequent discussions, the following areas for Energy Efficiency/Conservation were identified for Prospect of DPR:

In Case of Wire-drawing Industries:

- Proper Sizing of Motors and Use of Energy Efficient Motors
- Use of VFD in Speed Control of Motors
- Replacing Electrical Resistance Annealing Furnace with Oil Fired Annealing Furnace with in-built Air Pre-heater
- Use of Soft-Starter-cum-Energy Saver
- Replacing DC Motors with AC Motors including the Speed Control Device
- Use of alternative fuel, such as, employing bio-gasifies
- Use of Direct Drawing system in place of present practice of using multiple spools

In Case of Galvanizing Industries:

- Recovery of Waste heat from Exhaust Flue Gas for Pre-heating Combustion Air, Boiling/Heating Flux Solution, Drying Bed or Furnace Oil, as the case may be.
- Improvement of Furnace Wall Insulation

- Fuel Switching from Coal to Oil / Use of alternative fuel, employing bio-gasifier.

The following less prospective energy efficiency/conservation measures were found to be suitable for Case Study:

- Use of Maximum Demand Controller
- Efficiency Improvement in Pumping System
- Use of Capacitor Bank to improve Power Factor of Motors
- Improvement of Lighting and Fan System
- Employ V-belts with high efficiency in case of motors in wire-drawing sectors
- Expert monitoring and control system for the galvanizing process
- Design of Conveyer for Pre-heating Chamber, wherever applicable, for better recovery of waste heat and lowering of manpower

Table 3.16: Details of Technology Up-gradation Projects Identification of Cluster

Sl. No	Energy Conservation Measure	No. of DPRs	Replicability	Remarks
1	Replacing present motors with Energy Efficient Motors to improve efficiency	2	53	Replicability is high in the cluster however associated investment is very much
2	Usage of Air Pre-heater to recapture heat from the flue gas and warm the combustion air	2	53	High replicability. Three units are selected considering the furnace size
3	Using maximum demand controllers to shut down some machines when the ceiling of contract demand is hit	1	13	High replicability.
4	Using biomass instead of coal and installing gasifies.	1	7	High replicability.
5	Improving the insulation on furnaces to bring outside surface temperatures down to 60 deg C.	2	40	High replicability. High potential for three units.
6	Installation of Air-fuel Controller to Optimize the Excess Air	2	40	High replicability. Two units are selected considering the furnace size
7	Replacement of electric furnace with gas fired radiation furnace	1	7	High replicability.
8	Waste heat recovery from flue gas for preheating the job / flux solution before being galvanized.	1	27	High replicability. High potential for two units.
9	Replacing DC drive motors by AC drive with VFD control	1	7	High replicability. High potential for two units.
10	Use of Direct Wired Drawing Machines in Place of Conventional Multiple Stage Wire-drawing	1	7	High replicability. High potential for three units.
11	Usage of Soft Starters cum Energy Saver to prevent high currents during starts	1	40	High replicability
	TOTAL	**15**		

CHAPTER FOUR

4.0. ENVIRONMENTAL BENEFITS

The two main objectives of energy conservation measures are to improve resource efficiency and reduce waste so that galvanizing and wire-drawing businesses can be run more efficiently and become more environmentally sustainable. The achievement of environmental improvement program of one industry could help the exchange of specialized knowledge between other robust competitors. Inevitably, different plants may find different opportunities, but the overall results signal good prospects for further improvements across the industry as a whole. It is confidently predicted that these gains will prove to be conservative, and that long-term monitoring of the new procedures will show greater improvement. Further gains can be expected as levels of understanding and skill increase. The cohesion of the galvanizing and wire-drawing industry is pivotal to its ability to operate reliably and efficiently, and to deliver value in terms of both industry and community benefit.

4.1 Reduction in Waste Generation

Improved process could deliver quality improvements and other savings within the industry by allowing better monitoring of and hence improvements in plant management. The reduction in waste effluent and fume levels is one of the major environmental breakthroughs for these industries. The benefits are:

- A reduction or elimination of waste effluent solutions;
- A reduction in fume levels through optimum preflux controls;
- Minimal non-toxic residue.

4.2 Reduction in GHG emission such as CO_2

Among other greenhouse gases (GHGs) carbon-dioxide emissions are the largest contributors to 'greenhouse effect' that cause 'global warming' and result in 'climate change'. During detailed energy study, IISWBM team identified CO_2 emission reduction potential of each galvanizing and wire-drawing industries. Table 4.1 shows the possible CO_2 emission reduction for total 15 industries under study with respect to the type of fuel they used.

Table 4.1: Possible CO2 Savings Identified During Detailed Energy Study

	Coal	Wood	HSD	LDO	FO	Electricity	LPG	Total
	Ton/yr	Ton/yr	Ton/yr	Ton/yr	Ton/yr	kWh/yr	Ton/yr	Ton/yr
TOTAL (CO_2 reduction), Ton/yr	992	93	---	54	799	507	80	**2525**
TOTAL (CO_2 emission), Ton/yr	1358	1728	---	85	2205	3817	404	**9597**

Source: U.S. Department of Energy Information Administration

http:/www.eia.doe.gov/oiaf/1605/factor.htme; www.cea.nic.in

"CO2 Baseline Database for the Indian power Sector .User guide", June 2007 version 2.0.

Government of India Ministry of Power Central Electricity Authority

** Emission Factor = kg of CO2 per kg of fuel. in case of electricity kg of CO2 per kg of kWh*

The estimated CO_2 emission reduction can be traded and used to get financial benefit. Real-life impact of GHG emission is that the current generation enjoys the wealth through the different emission-producing activities, while the future generations have to bear the consequences. To reduce or to minimize those consequences Kyoto Protocol was formed with three cooperative emission reduction mechanisms - Clean Development Mechanism (CDM) is one of them. Through CDM galvanizing and wire-drawing industries could enjoy additional benefit. Thus, in 15 units, if the recommended measures are implemented, about 2525 Ton CO_2 emissions annually could be reduced out of total emission of 9597 Ton CO_2 per year.

4.3. Reduction in other emissions like SOx, etc.

Other than CO_2, other environmental issues of galvanizing and wire drawing industries are emissions to air, especially SOx; dust emissions from product handling etc. the main environmental aspects of wire drawing are: air emissions from pickling, acidic wastes and waste water; fugitive soap dust (dry drawing), spent lubricant and effluents (wet drawing), combustion gas from furnaces and emissions and lead-containing wastes from lead baths. During detailed energy study, IISWBM team also identified SO_2 emission reduction potential similar to CO_2 emission reduction potential of each galvanizing and wire-drawing industries. Table 4.2 shows the possible SO_2 emission reduction for each industry under study with respect to the type of fuel they used. Thus, in 15 units, if the

recommended measures are implemented, about 517 Ton SO_2 emissions annually could be reduced out of total emission of 3846 Ton SO_2 per year.

Table 4.2: Possible SO_2 Savings Identified During Detailed Energy Study

	Coal	Wood	HSD	LDO	FO	Electricity	LPG	Total
		Ton/yr	Ton/yr	Ton/yr	Ton/yr	kWh/yr	Ton/yr	Ton/yr
TOTAL (SO_2 reduction), Ton/yr	7.97	1	---	0.06	1.56	507	0	**517**
TOTAL (SO_2 emission), Ton/yr	10.91	14	---	0.10	4.30	3817	0	**3846**

Source: U.S. Department of Energy Information Administration

http:/www.eia.doe.gov/oiaf/1605/factor.htme; www.cea.nic.in

"CO2 Baseline Database for the Indian power Sector .User guide", June 2007 version 2.0.

Government of India Ministry of Power Central Electricity Authority

** Emission Factor = kg of CO2 per kg of fuel. in case of electricity kg of CO2 per kg of kWh*

CHAPTER FIVE

5.0. SMALL GROUP ACTIVITIES/TOTAL ENERGY MANAGEMENT

5.1. Introduction

Energy is one of the most important resources to sustain our lives. at present we still depend a lot on fossil fuels and other kinds of non-renewable energy. the extensive use of renewable energy including solar energy needs more time for technology development.

In this situation Energy Conservation (EC) is the critical needs in any countries in the world of special importance of Energy Conservation are the following two aspects:

(1) Economic factors

(2) Environmental impacts

5.1.1. Economic factors of Energy Conservation

Energy saving is important and effective at all levels of human organizations – in the whole world, as a nation, as companies or individuals. Energy Conservation reduces the energy costs and improves the profitability.

Notably, the wave of energy conservation had struck the Indian intelligential 3 years earlier when a Fuel Policy Committee was set up by the Government of India in 1970, which finally bore fruits three decades hence in the form of enactment of the much awaited Energy Conservation Act, 2001 by the Government of India. This Act made provisions for setting up of the Bureau of Energy Efficiency, a body corporate incorporated under the Act, for supervising and monitoring the efforts on energy conservation in India.

Brief History of energy efficiency movement in India and associated major milestones are as follows

- 1974: setting up of fuel efficiency team by IOC, NPC and DGTD (focus still on industry)
- 1975: setting up of PCAG (NPC main support provider) : focus expanded to include agriculture, domestic and transport

- 1978: Energy Policy Report of GOI: for the first time, EE as an integral part of national energy policy – provided detailed investigation into options for promoting EE
- Post 1980, several organizations started working in EC area on specific programs (conduct of audits, training, promotion, awareness creation, demonstration projects, films, booklets, awareness campaigns, consultant/product directories)
  - Some line Ministries and organizations like BICP, BIS, NPC, PCRA, REC, Ministry of Agriculture, TERI, IGIDR, CSIR, PETS (NPTI)
  - State energy development agencies
  - Industry associations
  - All India financial institutions

The Government of India set up Bureau of Energy Efficiency (BEE) on 1st March 2002 under the provisions of the Energy Conservation Act, 2001. the mission of the Bureau of Energy Efficiency is to assist in developing policies and strategies with a thrust on self-regulation and market principles, within the overall framework of the Energy Conservation Act, 2001 with the primary objective of reducing energy intensity of the Indian economy. This will be achieved with active participation of all stakeholders, resulting in accelerated and sustained adoption of energy efficiency in all sectors

Private companies are also sensitive to energy costs, which directly affects their profitability and even their viability in many cases. Especially factories in the industrial sectors are of much concern, because reduced costs by Energy Conservation mean the more competitive product prices in the world markets and that is good for the national trade balance, too.

5.1.2. Environmental impacts of Energy Conservation

Energy Conservation is closely related also to the environmental issues. the problem of global warming or climate change is caused by emission of carbon dioxide and other Green House Gases (GHGs). Energy Conservation, especially saving use of fossil fuels, shall be the first among the various countermeasures of the problem, with due considerations of the aforementioned economic factors.

5.2. Small Group Activities (SGA)

Small Group Activity (SGA) gives employees the problem solving tools they need to eliminate obstacles to Total Productivity, the culmination of zero break-downs, zero defects, and zero waste. Enterprising employees identify the problem, be it in "man, material, method, or machine," and develop cost-effective and practical methods for solving the problem.

5.2.1. Importance of SGA

SGA are activities by group of employees at operator (working Group) level. They aim to solve problems that occur at the place taken care of by each employee and put emphasis on participation and team work. Factories can apply small group activities to many kinds of work along with normal work or other measures that are already underway. The burden on employees will not increase because of small group activities. They are not only bringing benefits to factories but also boosting the knowledge and ability in performing jobs of employees, improving communication among employees, increasing creativity, and make it possible to express their own proposal with less hesitation to management. as a result, employees will start to think “This is our problem.” This SGA can be applied to Energy Conservation, too, with successful results, as shown in Figure 5.1.

5.3. How SGA leads to Energy Conservation

An excellent example of organizational structure that promotes energy management emphasizing participation is that they form overlapping small groups as in figure 14. the feature of this structure is that a small group for energy management is distributed to various sections as in figure 15, which is a recipe for success of Total Energy Management (TEM) and makes various communications and management of activities more efficient and effective.

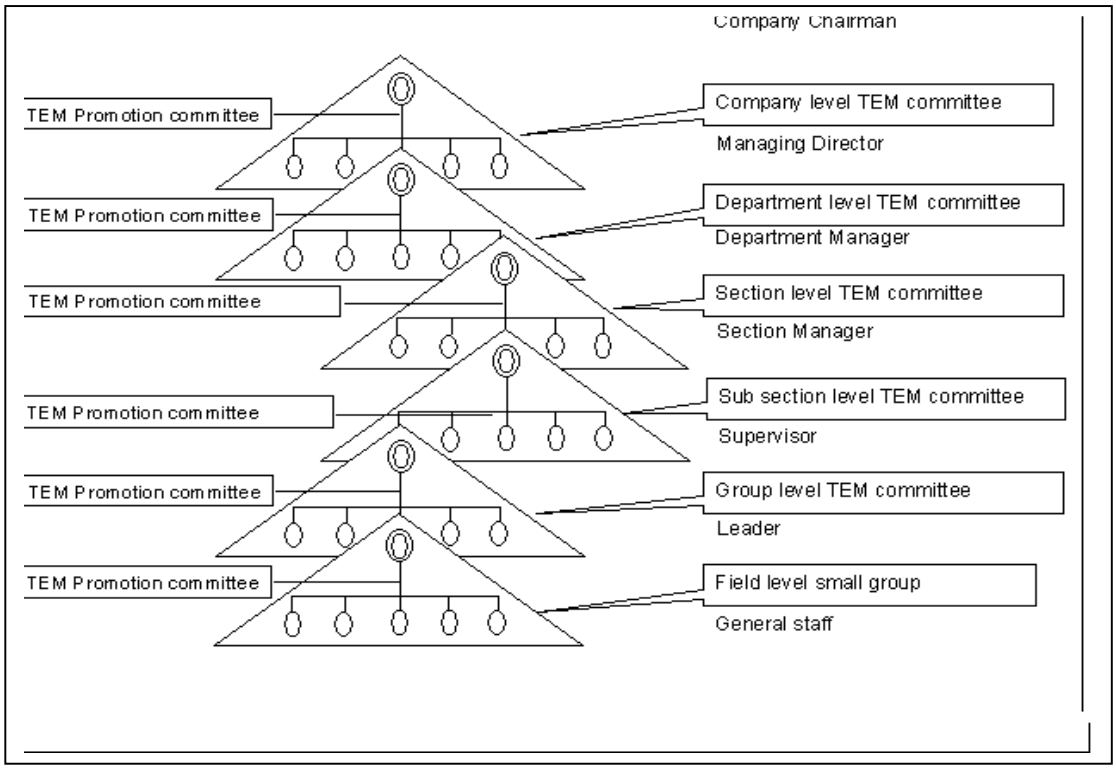


Figure 5.1: Relationship of SGA and energy saving

Small group activities for total energy management (TEM) are the activities in which employees of all levels in production or management, starting from the top to the bottom, participate in order to reduce loss related to their own job by improving their job. in order for the activities to succeed, management of all levels must provide support in necessary training and equipment, communication of policies, and the setting of problems to solve.

Small group activities for TEM can be divided into 4 or 5 levels depending on the scale of the organization. This division is in order to emphasize the fact that everyone must improve in their job under the responsibility to each other. It also enables us to make improvement without overlapping. the following example shows utilizing the existing job-related organization as much as possible, as already mentioned in Part 2, 2."Strategy for Improving the Efficiency of Energy Usage further", Step 2 Proper EC Organization including Assignment of Energy Manager (page 12).

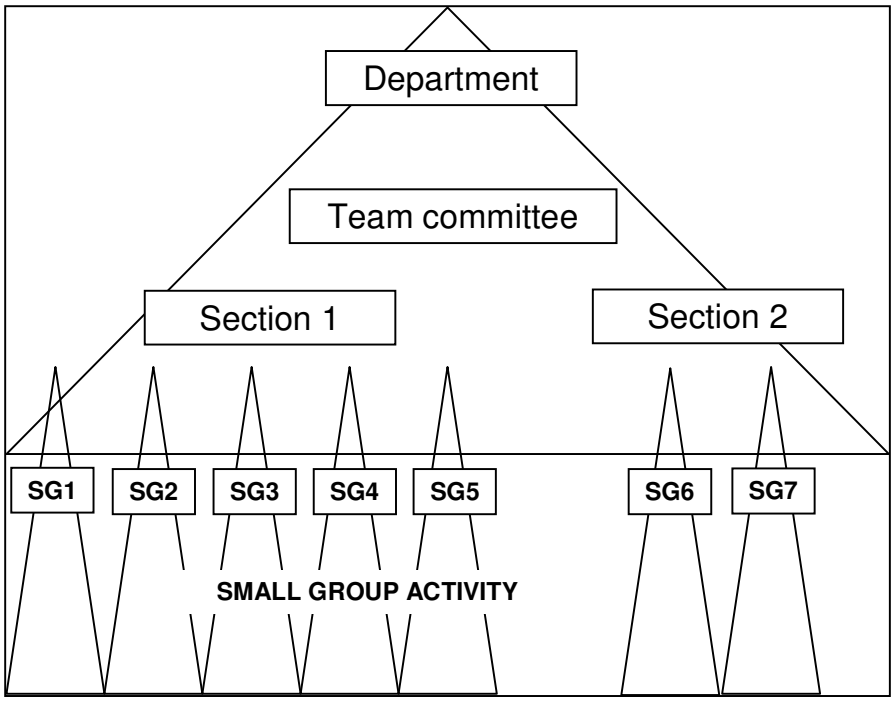


Figure 5. 2: Example of Organizational Structure with Overlapping Positioning of SGA in Main Job Structure

5.3.1. Executives level

- Define the policy and target for Total Energy Management
- Follow-up and manage activities to make sure that activities are implemented according to the policy
- Consider opinions and suggestions from the promotion office
- Consider reports from promotion committee from various levels

5.3.2. Level of Total Energy Management promotion office

- Make sure that whole activities are done in the correct direction, without delay and smoothly
- Find a suitable method that makes it possible to implement activities continuously and without slowdown
- Listen to opinions and suggestions from small groups in order to use for improving
- Provide advice for Total Energy Management to various groups

- Persons in charge of the office must be those with good personal relationship, friendly, and with spirit of good service

5.3.3. Medium level

- Define the policies of each department that are consistent with the policy of the Total Energy Management and the target of the company
- Define numerical targets to sub-groups apart from the target of the company as a whole
- Follow-up the progress in order to provide to sub-groups
- Report the progress along with suggestions and opinions to upper level committee periodically

5.3.4. Workers/Operators level

- Implement small group activities with various themes and achieve target
- Report progress and problems encountered during implementation to upper level committee periodically
- Ask for support, suggestions, and opinions from upper level committee

5.3.5. Responsibility of Energy Conservation committee

- Gather and analyze information on costs related to energy every month
- Analyze and solve problems related to energy
- Find a method for energy conservation
- Prepare energy conservation plan
- Follow-up the result of implementing the plan
- Perform activities such as public relationship for encouraging employees to participate
- Offer training to small group in each department

5.4. Steps of Small Group Activities for Energy Conservation

Small group activities for Energy Conservation can be done by using “10 Stages for Success”, based on “PDCA Management Cycle”, as shown below and in pictorial forms

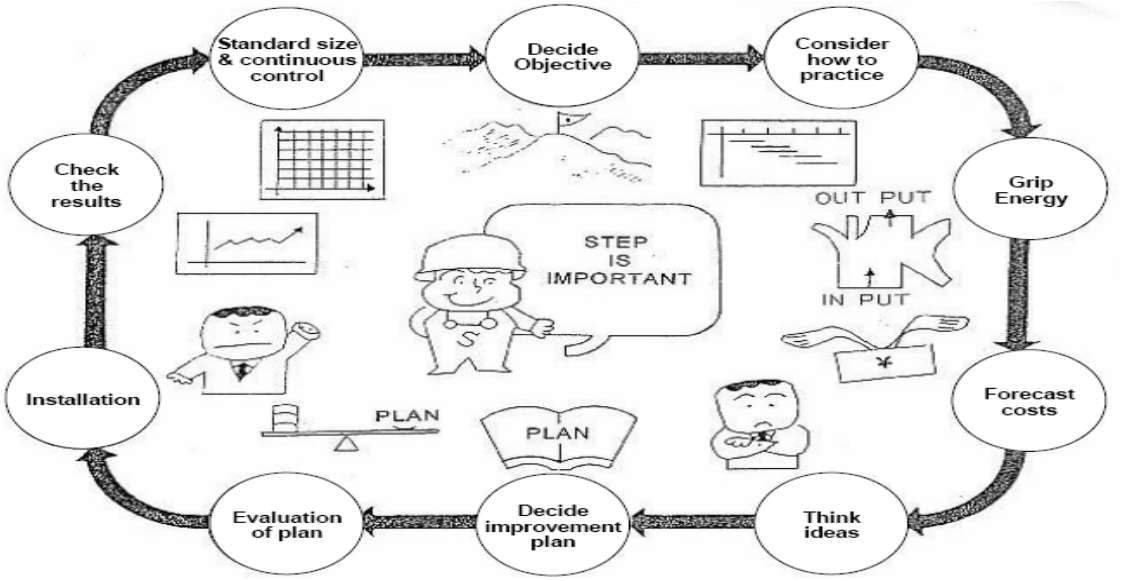


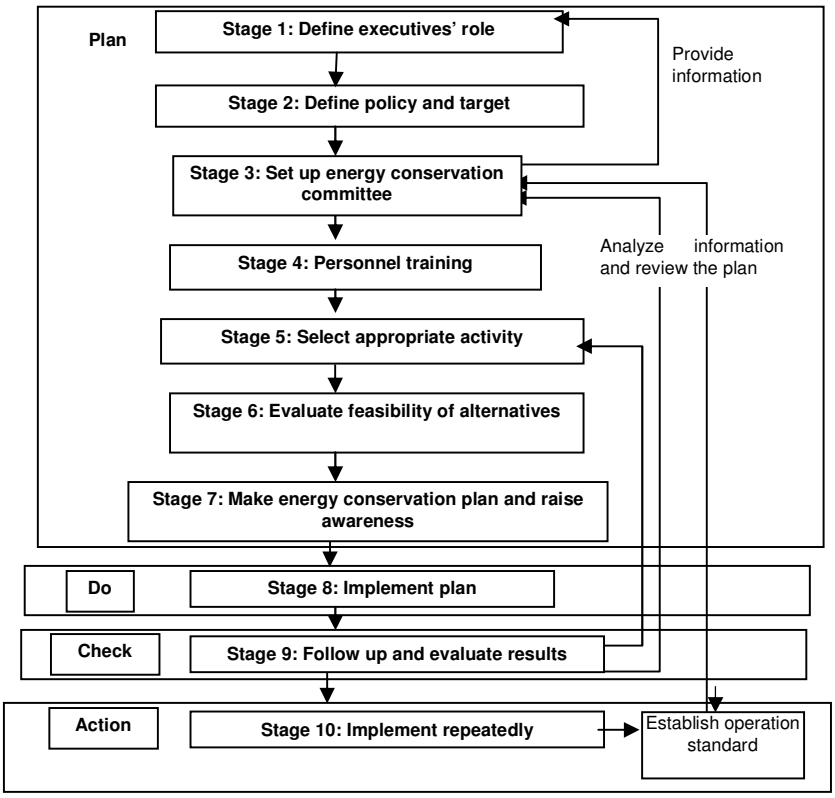
Figure 5.3: Steps of Small Group Activities for Energy Conservation

- Plan: Make an efficient plan in order to improve operation
- Do: Implement according to the plan
- Check: Check if implementation was according to the plan
- Act: Judge what to improve, what to learn and what to do from what we have checked

SGA circle

Figure 5.4: SGA Circle

Please note that these stages are substantially the same as "Key Steps" explained earlier, but put more stress on utilization of SGA. So readers could read and use either method up to their preference.



10 Stages for Success

Figure 5.5: 10 Stages for Success

5.4.1. Stage 1: Define Executive's Role

In promoting small group activities, support must be provided such as basic environmental support. Therefore, executives must provide follow up support to employees of their companies.

- Establish a special unit that provides support to small group activities
- Prepare a system for managing small group activities in the company
- Prepare annual plan for small group activities
- Prepare a venue for meeting, consultation, advice or suggestion
- Establish a system for giving rewards to high achieving employees

- Establish a reporting system starting from informing what to do until reporting of the results
- Establish a fair system for evaluating results
- Establish a system for providing support and training to employees

5.4.2. Stage 2: Define Policy and Target

- Executives must announce a policy of supporting small group activities.
- Energy conservation committee must act as an advisor in order to set a numerical target that is consistent with total energy management (TEM) policy and the target of the organization. Specific targets must be set for each group.

We can see that responsibilities in stages 1 and 2 are mainly those of executives and committee. Responsibility of employees will become clearer from stage 3 and afterwards.

5.4.3. Stage 3: Set up Energy Conservation Committee

The principle of small group activities (SGA) is to divide into groups based on the scope of responsibility. The size of the group will depend on the size of organization. However, size of the group should not be too large. Usually a size of 5 to 10 persons is considered appropriate. It is important to define responsibilities clearly so that every member of the group can have their responsibility and participate in the activities.

5.4.4. Stage 4: Personnel Training

This stage will help employees to have more knowledge and understanding, have new ideas, and have more belief in their own responsibility.

5.4.5. Stage 5: Select Appropriate Activity

In doing small group activities, each member must be able to think, express their own ideas, and make decisions based on reality and by investigating electrical equipment, machines, and office equipment that exist in the area of their responsibility. Items to consider include size, number, where to use, situation of usage, current situation, and the number of hour's usage per day.

By this we can evaluate the current situation of energy usage. Also by judging if there are more machines than needed, we can choose suitable activities and real problems for the organization.

5.4.6. Stage 6: Evaluate feasibility of alternatives (Analyze problems and decide on the measures and activities in each point)

Each group will gather ideas on the reasons for the problems, obstacles, and how to solve problems in order to decide on the problems, measures, and importance of activities and thus evaluate on the feasibility of activities to do based on advice from department manager. Basically, the following activities are not suitable for small group activities.

- Highly technical issues
- Issues that require a long time or many people to implement

We have identified the following problems through small group activities.

- Issues on material quality or production that influence energy usage
- Behavior on energy usage
- Efficiency of machines or equipment that uses energy
- Awareness toward environment and energy usage
- Safety costs for energy conservation

5.4.7. Stage 7: Make Energy Conservation Plan and Raise Awareness

Each group must prepare its activity plan. Generally, implementation for small group activities takes 6 months to 1 year. Activities to be implemented should correspond to the objectives of each group. Besides, it might help to listen to opinions of all organizations in order to receive support from all other organizations.

5.4.8. Stage 8: Implement Plan

Implement according to the plan of each group.

5.4.9. Stage 9: Follow Up and Evaluate Results

After implementing the plan, each member of small groups will follow up and evaluate the result by analyzing result, search for strong and weak points of activities, find a way to improve the activities and report on general achievement.

5.4.10. Stage 10: Implement Repeatedly

Energy conservation is an activity that must be implemented repeatedly. Therefore, it is necessary to implement each activity repeated and make improvement to each activity. If we are satisfied with the results, by achieving the objectives of activities, we should

provide rewards in order to give motivation for continuing the small group activities and implement creative activities.

Dos and Don'ts in Energy Conservation

- Ẋ Don't emphasize the mistakes in the past. It is better to talk about the present.
- Ẋ Don't be worried about the theory or principles. Don't spend too much time in discussion or analysis of problems in meeting rooms.
- Ẋ Don't think that an activity can be done perfectly from the beginning. It is necessary to do the job continuously by having experiences and judging by ourselves.
- ✓ Do start with an activity that requires small amount of investment.
- ✓ Do Raise awareness so that all employees understand the necessity and importance of energy conservation and participate in it.
- ✓ Do start the activity now without postponing to tomorrow.

5.5. Tools that are Used Often for Small Group Activities for Energy Conservation

5.5.1. 5S

5S is a contraction derived from the Japanese words **Seiri, Seito, Seiso, Seiketsu,** and **Shitsuke**. It is simple methodology that is also extremely useful in practical and realistic life. 5S is a set of actions to be followed through every day activities to advance the operational surroundings and circumstances. 5S is made in order to provide fortification to every personage in diverse profitable and industrialized fields. 5S is an extremely practical contrivance and skill set for anyone who wants to generate a more prolific environment within the workplace or who wants to make it their profession to make other people's businesses more proficient and productive. 5S occupy a list of products including eyewear, ear protectors and safety gears. Look into these different products that make up the significance of an industrialized security supply. Lean Six Sigma experts promise or guarantee for the efficiency of 5S as an enlightening enhancement to better working surroundings in an association. If you dig up Six Sigma guidance that is paid for by your company, you will be in a position to work for your company and make things better for you as well as for everyone. 5S is very useful in lots

of industries and job markets, but can often fail simply because of the lack of recognition concerning changes in the office.

Figure 5.6: 5S

5S consists of five steps that are crucial for the completion of 5S. The 5S steps are described as follows-

1. Seiri / 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.

2. Seito / **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.

3. Seiso / **Brush away**/ **Sweep**- 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.

4. Seiketsu / **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.

5. Shitsuke / **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.

5.5.2. QCC (Quality control circle)

QCC (Quality control circle) means controlling quality through group activities. for this, it is necessary to work hand in hand and achieve objective quality or customers' request. with this, we can find weak points, find the cause of problems, gather ideas for problem solving and systematically prepare quality and thus, solve problems such as material loss, production costs, working hours, or productivity. This is also a very useful tool to tackle with Energy Conservation problem. So many factories or institutions are encouraged to utilize this tool.

CHAPTER SIX

6. SUMMARY

In this section summary of energy use and technology studies conducted in Howrah Galvanizing & Wiredrawing cluster is discussed, which include identified energy conservation measures, its energy & monetary benefits, payback period, issues in implementation are discussed.

6.1. All Energy Saving Proposals/Measures Identified for the Howrah Cluster

Table 6.1: List of Energy Conservation Measures Identified

Sl. No	Energy Conservation Measure
1	Replacing present motors with Energy Efficient Motors to improve efficiency
2	Usage of Air Pre-heater to Recapture Heat from the Flue Gas and Pre-heat the Combustion Air
3	Using maximum demand controllers to shut down some machines when the ceiling of contract demand is crossed
4	Using biomass instead of coal and installing gasifiers.
5	Improving the insulation on furnaces to bring outside surface temperatures down to 60 deg C.
6	Installation of Air-fuel Controller to Optimize the Excess Air
7	Replacement of electric furnace with gas fired radiation furnace
8	Waste heat recovery from flue gas for preheating the job or flux solution before being galvanized.
9	Replacing DC drive motors by AC drive with VFD control
10	Use of Direct Wired Drawing Machines in Place of Conventional Multiple Stage Wire-drawing
11	Usage of Soft Starters cum Energy Saver to prevent high currents during starts

6.2. Techno-Economics (Cost, Savings and Simple Payback Period) for All Energy Saving Proposals

Sl. No	Energy Conservation Measure	Annual Energy Saving Potential			Potential Saving ₹/year	Investment ₹	Payback Period Years	No. of Units out of 15, may adopt technology	No. of Units out of 101, may adopt technology	Total Saving Potent-ial ₹
		Elec., kWh	Heat, GCal	Total, kGCal						
1	Replacing present motors with Energy Efficient Motors to improve efficiency	30041		26	171817	364451	2.12	8	53	9163547
2	Load Point Capacitor Bank	4632		4	25548	9510	0.37	11	73	1873513
3	Usage of Soft Starters cum Energy Saver to prevent high currents during starts	26327		23	152625	180000	1.18	6	40	6104987
4	Usage of Air Pre-heater to Recapture Heat from the Flue Gas and Pre-heat the Combustion Air		108	108	277382	137500	0.50	8	53	14793680
5	Using film gas burner and installing APH		158	158	433575	500000	1.15	1	7	2890500
6	Using biomass instead of coal and installing gasifiers.		1000	1000	1500000	1000000	0.67	1	7	10000000
7	Improving the insulation on furnaces to bring outside surface temperatures down to 60 deg C.		167	167	487632	34060	0.07	6	40	19505273
8	Using maximum demand controllers to shut down some machines when the ceiling of contract demand is crossed	7004	0	6	56930	25000	0.44	2	13	759067
9	Installation of Air-fuel Controller to Optimize the Excess Air		142	142	417342	74221	0.18	6	40	16693687
10	Replacement of electric furnace with gas fired radiation furnace		53	53	144164	450000	3.12	1	7	961093
11	Waste heat recovery from flue gas for preheating the job or flux solution before being galvanized.		463	463	799350	156250	0.20	4	27	21316000

Sl. No	Energy Conservation Measure	Annual Energy Saving Potential			Potential Saving ₹/year	Investment ₹	Payback Period Years	No. of Units out of 15, may adopt technology	No. of Units out of 101, may adopt technology	Total Saving Potent-ial ₹
		Elec., kWh	Heat, GCal	Total, kGCal						
12	Saving by waste heat recovery from flue gas for preheating the job.		239	239	681560	100000	0.15	1	7	4543733
13	Solar Photo Voltaic cell	33639		29	165169	2618000	15.85	1	7	1101127
14	Savings in Light and fans	4539		4	24741	15236	0.62	13	87	2144233
15	Use of Direct Wired Drawing Machines in Place of Conventional Multiple Stage Wire-drawing	79845		69	672295	750000	1.12	1	7	4481967
16	Replacing DC drive motors by AC drive with VFD control	48026		41	404381	800000	1.98	1	7	2695873
	TOTAL	**234054**	**2329**	**2530**	**6414510**	**7214228**	**1.12**	**71**		

It may be noted that the figures such as saving, investment etc. shown in above for each ECMs are obtained from the identified units calculations of savings but averaged to represent the Howrah Cluster.

6.3. Summary of level of awareness on energy efficiency and energy efficient products in the cluster

Level of awareness on energy efficiency and energy conservation products in the Howrah Galvanizing and Wire-drawing cluster is poor, due to below mentioned reasons.

- Lack of awareness on the Energy efficiency
- One-man being responsible for so many issues, energy issues do not come up in application
- Lack of organizational commitment
- Narrow focus on Energy
- Not clear about their existing level of operations and efficiency, due to lack of instrumentation & non availability of Energy consumption data
- Limited manpower
- Lack of trained manpower
- Limited information on new technologies
- Cost of Energy conservation options

Table 6.3: Annual Energy Consumption of Various Energy Sources in Galvanizing and Wire Drawing Units in Howrah Cluster

Sl. No.	Type of Unit	Electrical Energy Consumption (₹/Yr)	Fuel Consumption (₹/Yr)	Gross (₹/Yr)
1	Galvanizing	4176289	46179563	50355852
2	Wire-drawing	11688820	12906820	24595640
	TOTAL	15865109	59086383	74951492

Major energy sources being used in cluster are Electrical energy in case of Wire-drawing units and thermal energy from fuels such as FO, coal, Wood & LPG. Annual electrical energy consumption and fuels in Howrah Galvanizing and Wire-drawing cluster is costing around ₹ 15865109 for electricity and ₹ 59086383 for fuels. Total energy consumption in the (15 Units of) Howrah Galvanizing and Wire-drawing cluster is costing

around ₹ 74951492. After implementation of proposed energy conservation measures will save the 571718 kWh of electrical energy, 80227 kg of wood 13139 kg of LPG and 255439 liter of FO. Annual energy saving potential identified in cluster (in 15 Units) is saving of ₹ 16777566, which is around 22% of total energy consumption. For the entire cluster the estimated total saving potential for 101 Galvanizing and Wire-drawing units is ₹ 112968944, if all the recommendations made in the present study were implemented.

Annexure 1

List of Galvanizing and Wire-Drawing Units in Howrah Cluster

A. List of 30 Galvanizing and Wire-Drawing Units in Howrah Cluster where Audit was conducted

Sl. No.	Units Name	Product	Capacity	Units	Raw Material	Level of Audit
1	Eastern Copper Mfg. Co, (P) ltd	Copper Wire Rods and Conductors	1000	TPA	Copper Wire Rods	Detailed
2	ECO Industries	High Carbon Wire	3500	TPA	High Carbon Wire	Detailed
3	Eri Tech Ltd	MS Wire and Aluminum Wire	2700	TPA	MS Wire and Aluminum Wire	Detailed
4	G. S. Steel Industries	MS Wire	300	TPA	MS Wire	Detailed
5	Panel Pin Manufacturing co.Pvt Ltd	MS Wire & High Carbon Wire	3500	TPA	High Carbon Wire	Detailed
6	S. M. Industries	MS Wire	241	TPA	MS Wire	Detailed
7	Techno Iron & Steel Co.	MS Wire	600	TPA	MS Wire	Detailed
8	Vijaya Engineering Works	MS Wire	2750	TPA	MS Wire	Detailed
9	Jeen Ferrow Alloy Industries	Aluminium Wire	100	TPA	Alluminium Wire	Prelim.
10	Shiv Shakti Engineering Works (Wire-drawing)	MS Wire	100	TPA	MS Wire	Prelim.
11	Ashoke Merkantile	MS Wire	750	TPA	MS Wire	Prelim.
12	S. M. Engineering Works	MS Wire	150	TPA	MS Wire	Prelim.
13	Gradient wire products Pvt. Ltd	EDM wire & Brass wire	200	TPA		Prelim.
14	Associated Industries	MS wire & Nail	270	TPA	MS Wire	Prelim.
15	Hind Engineering works	MS Wire	150	TPA	MS Wire	Prelim.
16	Nehar Eng Pvt Ltd	MS Wire	300	TPA	MS Wire	Prelim.
17	Eskay Engg. Works	Nail & MS wire	210	TPA	MS Wire	Prelim.
18	Prasant Wire Industries	MS Wire	800	TPA	MS wire	Prelim.

19	A. R. Power Project	Transmission Tower Products galvanized	7500	TPA	Zinc	Detailed
20	Inza Galvanizing co.	Transmission, Microwave and Substation Tower structure galvanized	3750	TPA	Zinc	Detailed
21	L.G. Corporation	Fasteners Item galvanized	4320	TPA	Zinc	Detailed
22	Modern Malleables Ltd	Transmission Line and Insulator fittings galvanized	1200	TPA	Zinc	Detailed
23	Narayan Wires Pvt. Ltd.	Galvanized MS wire	3650	TPA	Zinc	Detailed
24	Steel & Fence co-operation	Fasteners Item galvanized	890	TPA	Zinc	Detailed
25	Sun Steel Industries Pvt. Ltd	Fabrication and galvanizing on transmission tower structure	1969	TPA	Zinc	Detailed
26	Howarh Galvanising works	Hightension line related things galvanizing	200	TPA	Zinc	Prelim.
27	DMS Galvanising works	Galvanized Channel	150	TPA	Zinc	Prelim.
28	Neha Galvanizer (India) Pvt Ltd	Iron Srap & channel galvanizing	1200	TPA	Zinc	Prelim.
29	J. R. Galvanizing	Clamps & bolts galvanizing	250	TPA	Zinc	Prelim.
30	Shiv Shakti Eng. Works (Galvanizing)	Fasteners Item galvanized	760	TPA	Zinc	Prelim.

B. *List of Remaining 71 Galvanizing and Wire-Drawing Units in Howrah Cluster where Audit could not be Conducted*

Sl. No.	Units Name	Product	Raw Material
1	Avay Kali enterpriese	MS Wire	MS Wire
2	Hind Engineering works	MS Wire	MS Wire
3	Ganapati wire	MS Wire	MS Wire
4	Maheshwary Metal & Alloys pvt. Ltd	MS Wire	MS Wire
5	Hanuman steel wires pvt. Ltd	MS Wire	MS Wire
6	K.R.Wire	MS Wire	MS Wire
7	Leser cable	Wire cable	
8	Micro metal pvt. Ltd	MS Wire	MS Wire
9	KB Steel Industries	Ribbed wire	
10	Radhika Transmission	Aluminum wire	
11	Calcurt ferrous	Pressurised Concrete wire	
12	Sree Udyog	MS Wire	MS Wire
13	Bimala enterprises	MS Wire	MS Wire
14	J.K.Wire & Engineering		
15	Jai Ambe Udyog	MS Wire	MS Wire
16	A.K.Engineering	MS Wire	MS Wire
17	Giriraj Udyog	MS Wire	MS Wire
18	Eastern Weldmesh pvt. Ltd	MS Wire	MS Wire
19	Sitaram metals	MS Wire	MS Wire
20	Gel Copper	Copper wire	
21	Precision wire	MS Wire	MS Wire
22	S.S.G	MS Wire	MS Wire
23	JPR		
24	Swastic wire	GI wire	
25	Kritika wire		
26	ShiV Shakti Enterprises	MS Wire	
27	MESCAB	Copper wire	
28	Unique Industries corporation		
29	Bandana Industries		
30	Bharat Industries		
31	S.V.Merchendies		
32	Allied wire pvt. Ltd		
33	Murshed Galvanising works	Chanel and Angel	Zinc
34	Moon Light Galvanising works	Pipe and chanel	Zinc
35	Kaderia Galvanising works	Nut and bolt	Zinc
36	The Laila Galvanising	Chanel and Bolt	Zinc

Sl. No.	Units Name	Product	Raw Material
37	Unique Galvaniser	Transmission tower structure	Zinc
38	Bengal Galvanising works	Nut and bolt	Zinc
39	Shree Balajee eng.	Socket Iron Scrap	Zinc
40	Ma Tara Galvanising works pvt. Ltd		Zinc
41	F.M. Galvanising	Pipe and Socket	Zinc
42	Mangal Steel Enterprises	Angel and chanel	Zinc
43	Hobb International Pvt. Ltd	Iron Scrap	Zinc
44	Sitara conductor & Cables		Zinc
45	Raj Steel Processors		Zinc
46	Hi-Tech eng. Works		Zinc
47	Sree Maa Sarada Fabrication & Eng (p) Ltd		Zinc
48	Jai Guru Galvanising	Nut and bolt	Zinc
49	S.M.Industries(Galvanizing)	Chanel and Angel	Zinc
50	Ma-Lakshmi Galvanizing Works		Zinc
51	Hazzi Heritage	Chanel and Angel	Zinc
52	J.R. Galvaniser		Zinc
53	J.J.Udyog		Zinc
54	D.M.P Projects Pvt Ltd		Zinc
55	Steel Product Ltd		Zinc
56	Ucic Pvt Ltd		Zinc
57	Spint Communication		Zinc
58	R.K.Industries		Zinc
59	Raj Steel Processors		Zinc
60	S.Mondal & co		Zinc
61	Nangalia Group		Zinc
62	Ratan Projects & Eng. Pvt Ltd.		Zinc
63	North East Forging Pvt Ltd		Zinc
64	A-one Galvanising works		Zinc
65	Eastern Steel		Zinc
66	New Deluxe Galvanising works		Zinc
67	S.Mondal & co		Zinc
68	Everst Galvanising works		Zinc
69	Gowsia Galvanising works		Zinc
70	Maheswari & co		Zinc

Annexure 2

DETAILED TECHNOLOGY/EQUIPMENT ASSESSMENT REPORT

The detailed technology/equipment assessment report has been provided for the furnace efficiency improvement by Air-preheater (APH) Energy Conservation Measure. A lot of heat escapes the system with the flue gas. Any attempt to re-circulate the heat back into the system would amount to savings. One such scheme would be to heat the combustion air beforehand using this flue gas. For this purpose, the exhaust gas could be passed through a heat exchanger. The combustion air would gain some extra heat during this exchange process. The figure A shows the fuel conservation rate in such a pre-heating scheme.

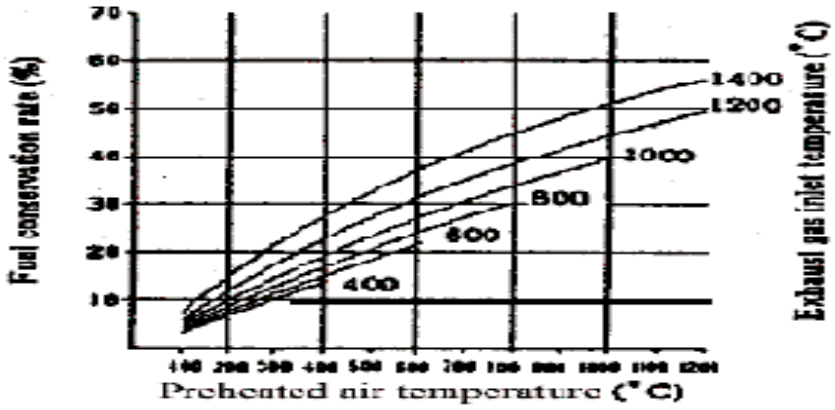


Figure A: Fuel Consumption Rate (%) when oil is used

Design of the suggested Air Pre Heater

An air preheater was designed to draw heat from the flue gas while it passes through the stack. The design is shown in the Fig. B. There are fins located vertically on the outer surface of the stack to enable the air to be heated while it circulates more around the stack and thus enhance the heat transfer rate.

The retrofit would be like a jacket, put on the lower portion of the chimney. The dimensions in mm are put in the figure. The outer surface of the retrofit as well as the pre-heated air pipe going out of this should be lagged.

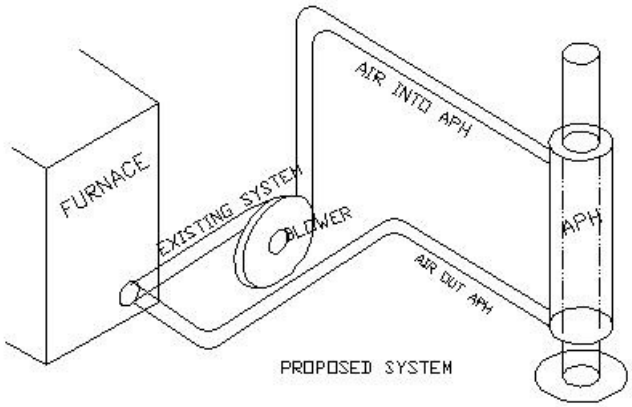


Fig B: Air Pre-Heater to heat combustion air (for running system and proposed over-ground system)

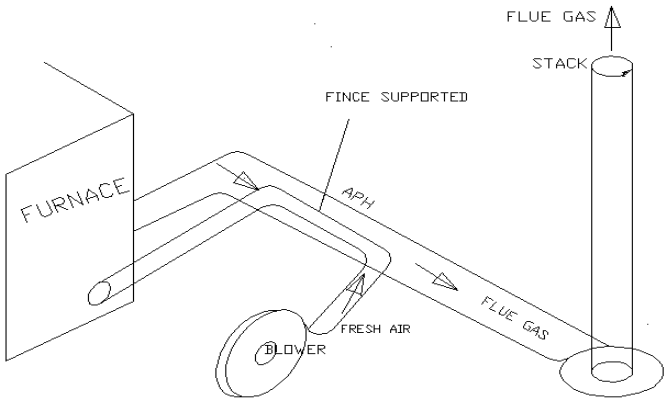


Fig C: Air Pre-Heater to heat combustion air (for proposed under ground system)

IISWBM Energy Team was invited by the company a number of times for guidance and discussions on implementation. For example, on September 29, 2010, a new system design emerged through discussions with the industry for the new galvanizing line (approx 750 tonnes per annum) under commissioning in the same unit. The horizontal tube heat exchanger pipe (carrying air from blower) would be made of SS as it would be surrounded by the outgoing flue gas from the furnace. The performance of heat exchanger would be improved also because it would be located closer to the furnace outlet where the flue gas temperature would be hotter by about 100 deg C.

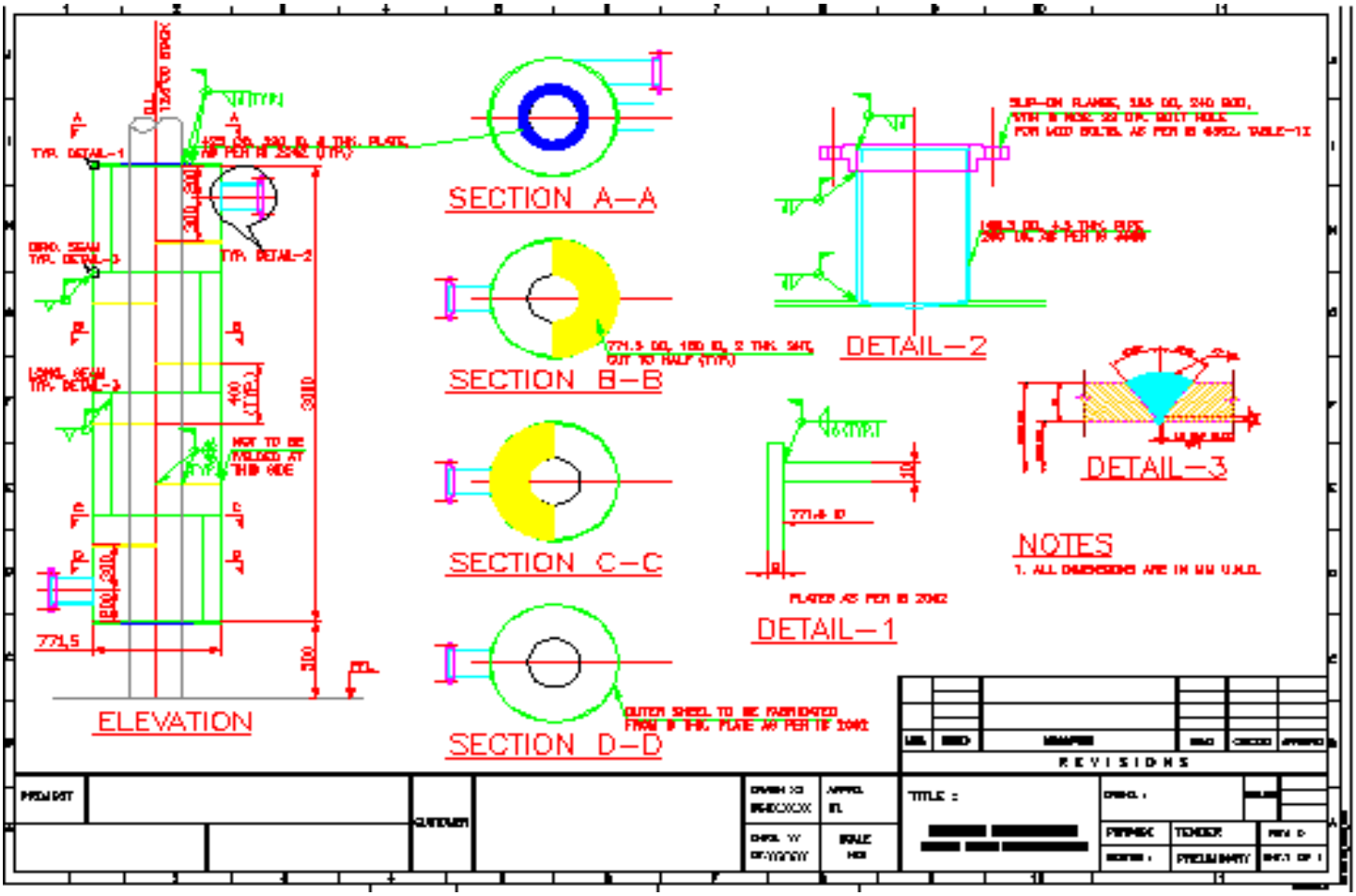


Fig D: Design of the Air Pre-Heater

Sample Calculation of saving in Using Exhaust Gas to preheat the combustion air by adding air-preheater (blanket to the existing chimney)

As per the BEE Book 2 page no 113, for exhaust gas temperature 600 deg C, the potential for raising the preheated air temperature is 400 deg C. However, considering a rise of upto 400 deg C saving potential for fuel would be more than 15 %.

Therefore a conservative estimate of 10 % fuel saving would be reasonable and would mean a monitory saving of ₹ 334688.

(Annually FO consumption ₹ 3346875

10 % of ₹ 3346875 = ₹ 334688)

Probable Investment ₹ 150000

Simple Payback Period = Probable Investment / Savings X 12

= 150000/334688 X 12

= 5 months

Estimated Life of the proposed system: 10 years.

So, Depreciation Cost = (Investment / Estimated Life of the Proposed System)

= ₹ 15000

Therefore,

Return on Investment (ROI)

= {(Net annual Saving – Depreciation Cost) / Investment} X 100%

= 213 %/yr.

Annexure 3

DETAILS OF TECHNOLOGIES/SERVICES PROVIDERS FOR THE CLUSTER

Sl. No.	Name	Contact No.	Email	Service
1	Mr. Ahmed	9830341257		Furnace
2	Mr. Anjan Majumdar	9432121623	anjan_6005@rediffmail.com	Electrical Systems
3	Mr. B.N. Mishra	9903418226	bibhutinathmishra@yahoo.com	Furnace
4	Mr. Bimal Mondal	9732574279		chimney
5	Mr. Brij Bhusan Upadhaya	9331013596	brijupadhyay@gmail.com	Management Function and Materials Supply
6	Mr. Kaushik Bose	9331053249	kb.kol@lloydinsulation.com	Insulation
7	Mr. Manas Bag	9830631014	mbag31@rediffmail.com	Electrical Systems
8	Mr. S.K. Dutta	9433119963	enconskd@gmail.com	Furnace
9	Mr. S.K. Ghosh	9830026535	sushil_ghosh@vsnl.net	Wire drawing M/c
10	Mr. Tarun Guha	9830105553	energyindia@vsnl.net	Electrical Systems
11	Mr. R P Tyagi	9820030909	wiremachine@amcoindia.com	Wire drawing M/c
12	Mr. S. K. Kundu	9830082313	indiaenergysaver@gmail.com	Motor & electrical system
13	Mr. Suman Chatterjee	9433002919	info@cgmepl.com	VFD
14	Mr. Vishal Sharma	8981958741	vis_shalu@rediffmail.com	Furnace
15	Mr Sourabh Choudhury	9831057357	info@industrialindia.com	Energy efficient equipment
16	Mr. Surendra Mohta	9433014351	scoinfo@rediffmail.com	Energy efficient motor
17	Mr. Somnath Passi	09810204887		Direct Wire drawing m/c
18	Mr. Anjan Nath	Ph:24166728 Mob: 9830483597		VFD

Sl. No.	Equipment Supplier	Contact No.	Email	Product
1	ABB Ltd	91 0129 2233313-15		Energy Efficient Motor
2	ABB Motors	91 0129 2233313-15		
3	Aditya Energy System	91-11-26026081, 26027796	satish@adityasolar.in	
4	Ambetronics Engineers Private Limited	+91-22-66995525, 28371143	lamtec@ambetronics.com	
5	Anurup Engineering Services	9038871988/7890478540	anupkdey@yahoo.com	
6	Asian Electronics Ltd	033-2465 0239 / 0589	aelcal@cal2.vsnl.net.in	Energy Efficient Light Suppliers
7	Crompton Greaves Ltd	033-2282-9681-85		
8	ENVIRON ENERGY TECH SERVICE LTD.	9831020032		
9	EPCOS India Pvt. Ltd.	033-24428476	eipsales@epcos.com	Load Point Capacitor Bank
10	G. P. Sales	91 657 2292714	gpsales@rediffmail.com	Energy Saver Cum Soft Starter
11	Instapower Ltd.	011-26015000		
12	Jeltron Systems (India) Pvt.Ltd.	040-23311159, 23322586/7	Jeltron@hrd.vsnl.net.in	
13	Kirloskar Electric	3291 6080	info@industrialindia.co	Variable Frequency Drive (VFD)
14	Larsen & Toubro India Pvt.Ltd.	022-55051401/11, 022-55051731	esp-bom@Lntebg.com	
15	Lloyd Insulations (India) Ltd.	22871606, 22465687	lloydinsulation.com	Furnace Insulation

Sl. No.	Equipment Supplier	Contact No.	Email	Product
16	Siemens Ltd. (Electric Motors, Automation & Drives Division.)	91 - 22 - 27600001		
17	SIGMA STEEL & Engineers pvt. Ltd	(033) 32953536	sigma3000@hotmail.com	
18	Syntron Controls	022-2238-9023	sales@ Syntron-controls.com	
19	Techmark Engineers & Consul	9861133492	jpnanda@techmark.co.in	Oxygen sensor for VFD control
20	Transparent Energy Systems Private Limited.,	044 - 32905249	chennai@tespl.com	Pre heating furnace fabrication
21	ENCON Thermal Engineers Pvt. Ltd. (Room No-502, 9 Queen's Mansion; 12, Park Street Kolkata - 700 071)	Tel. No. : +91-129-4041185, 4047847 Tel. No. : +91-129-4164829, 4164833 Fax No. : +91-129-4044355	kolkata@encon; sales@encon.co.in	Radiant Furnace (Gas Fired) to replace electrical furnace
22	Technosoft Consultancy Services	9230056795	contact.tcskolkata@gmail.com	EE motors, VFD and Control system
23	GP GREEN ENERGY SYSTEMS PVT. LTD.	+91-33-2321 0809 / 2358 0114	info@gpenergy.net	Biomass gasifier
24	Ankur Scientific Energy Technologies (P) Ltd.	Ph: 0265 - 2793098/2794021 Direct Line: +91-265-2788447,Fax: 0265 - 2794042	ascent@ankurscientific.com	Biomass gasifier
25	Wesman Engineering Company	9831868732	prasant.saha@wesman.com	Furnace

Annexure 4

QUOTATIONS OR PRICES FROM SERVICE/TECHNOLOGY PROVIDERS ENERGY EFFICIENT MOTORS

EFF 1

MHLP 1A
Revision-3

Energy Efficient Motors

Totally Enclosed Fan Cooled (TEFC) Squirrel Cage Motors - Foot Mounted (B3)
Horizontal Foot mounted Induction motors, continuously rated suitable for operation on 415 Volts ± 10%, 3 Phase, 50 Hz ± 5%, AC Supply with Class 'F' insulation and temperature rise limited to Class 'B', for an ambient of 50°C and altitude less than 1000m above MSL, IP 55 Protection and conforming to IS 325:1996 / IS 12615:1999

OUTPUT				4 POLE - 1500 RPM	
Kw	Hp	Frame	Cat. Ref.	List Price (Rs)	Excise Duty (Rs)
0.06	0.08	MHHE56ZAA4	MHHETAS40X06	7,078	328
0.09	0.12	MHHE56ZBA4	MHHETAS40X09	7,122	330
0.12	0.16	MHHE63ZAA4	MHHETBS40X12	7,236	335
0.18	0.25	MHHE63ZBA4	MHHETBS40X18	7,445	345
0.25	0.33	MHHE71ZAA4	MHHETCS40X25	7,622	353
0.37	0.50	MHHE71ZBA4	MHHETCS40X37	7,894	366
0.55	0.75	MHHE80ZAA4	MHHETDS40X55	9,209	427
0.75	1.00	MHHE80ZBA4	MHHETDS40X75	9,197	426
1.1	1.50	MHHE90SAA4	MHCETES401X1	10,645	493
1.5	2.00	MHHE90LBA4	MHCETFS401X5	11,625	539
2.2	3.00	MHHE100LAA4	MHCETGS402X2	15,446	716
3.7	5.00	MHHE112MAA4	MHCETHS403X7	19,829	919
5.5	7.50	MHHE132SZA4	MHCETIS405X5	27,299	1,265
7.5	10.00	MHHE132MZA4	MHCETJS407X5	31,840	1,476
9.3	12.50	MHHE160MYA4	MHCETKS409X3	50,663	2,348
11	15.00	MHHE160MXA4	MHCETKS40011	51,030	2,365
15	20.00	MHHE160LXA4	MHCETLS40015	63,377	2,938
18.5	25.00	MHHE180MXG4	MHCETMS4018X5	85,716	3,973
22	30.00	MHHE180LXG4	MHCETNS40022	91,234	4,229
30	40.00	MHHE200LNG4	MHCETOS40030	1,23,396	5,719
37	50.00	MHHE225SN4	MHCETPS40037	1,58,534	7,348
45	60.00	MHHE225MN4	MHCETQS40045	1,92,172	8,907
55	75.00	MHHE250MN4	MHCETRS40055	2,64,179	12,245
75	100.00	MHHE280ST4	MHCETSS40075	3,38,407	15,685
90	125.00	MHHE280MT4	MHCETTS40090	3,92,101	18,174
110	150.00	MHHE315SYE4	MHCETUS40110	4,49,202	20,820
132	180.00	MHHE315MYE4	MHCETVS40132	5,28,858	24,513
160	220.00	MHHE315MZE4	MHCETVS40160	5,90,282	27,360
200	270.00	MHHE315LZE4	MHCETWS40200	7,53,363	34,918
225	300.00	MHHE355MA4	MHCETYS40225	7,70,853	35,729
250	340.00	MHHE355MB4	MHCETYS40250	7,93,612	36,784
275	370.00	MHHE355MC4	MHCETYS40275	8,40,725	38,968
315	425.00	MHHE355LA4	MHCETZS40315	9,50,400	44,051
335	450.00	MHHE355LB4	MHCETZS40335	10,28,379	47,665
350	470.00	MHHE355LC4	MHCETZS40350	12,25,400	56,797

Note: Havells standard motors in frame 315 and above are at no extra cost

Intermediate Ratings (Class F insulation with temperature rise limited to Class F)

OUTPUT				4 POLE - 1500 RPM	
Kw	Hp	Frame	Cat. Ref.	List Price (Rs)	Excise Duty (Rs)
0.25*	0.33	MHHE63ZCA4	MHHETBS40X25	7,527	349
0.55	0.75	MHHE71ZCA4	MHHETCS40X55	9,019	418
1.1	1.50	MHHE80ZCA4	MHHETDS401X1	10,449	484
1.8	2.50	MHHE90LCA4	MHCETFS401X8	13,194	612
2.2	3.00	MHHE90LDA4	MHCETFS402X2	15,098	700
3.0*	4.00	MHHE100LBA4	MHCETGS40003	17,090	792
3.7	5.00	MHHE100LCA4	MHCETGS403X7	19,139	887
5.5	7.50	MHHE112MBA4	MHCETHS405X5	27,375	1,269
9.3	12.50	MHHE132MRA4	MHCETJS409X3	45,920	2,128
11	15.00	MHHE132MTA4	MHCETJS40011	50,069	2,321
30	40.00	MHHE180LRG4	MHCETNS40030	1,20,788	5,599
37	50.00	MHHE200LFG4	MHCETOS40037	1,58,322	7,338
75	100.00	MHHE250MK4	MHCETRS40075	3,37,886	15,661

** Class F insulation with temperature rise limited to Class B*

HAVELLS

Havells Lafert Motors
Price List w.e.f. 1st April 2010
Manufactured with Technology from AEG Electric Motors

Control for VFD

from Technosoft Consultancy&Services <contact.tcskolkata@gmail.com> Sep 17

to Binoy K Choudhury <binoykchoudhury@gmail.com>

date Fri, Sep 17, 2010 at 9:40 AM

subject Re: BEE SME Howrah Galvanizing & Wire-drawing Energy Project

mailed-by gmail.com

signed-by gmail.com

GOOD MORNING SIR !

Please refer to our discussions last afternoon regarding incorporation of alarm for overload prewarning and to slowdown the drive

untill current comes below the critical level. Cost of components including service charge to depute engr. --Rs. 7,000=00/-

Thanks & Regards

R. SHAH (9230056795)

for Technosoft Consultancy & Services

Please Visit: www.tcskolkata.com

Dear Sir / Madam,

We,Associates of Kirloskar Electric Co. Ltd, hereby take this opportunity to introduce ourselves as **dynamic &professionally**

managed organization, Estd 2001.involved in **Consultancy, Trading , Manufacturing & After Sales Supports** of **e**Power ,

Process & Pollution Control Systems , Factory & Building Automation Products , Industrial Equipment & Critical Spares **.**

…

Our dealings are in the following Industrial regions:- Sponge Iron & Steel , Cement ,Ceramics, Carbon, Chemicals,

Textile & Hosiery , Jute & Rice Mills , Power Plants, Rolling Mills , Oil & Gas , Machine Tools , Electroplating, Paper,

Plastics, Packaging & Printing, Rubber & Leather , Food Products & Beverage , Technical & Medical Institutions , Banks &

Offices , Indian Railways , Indian Defense, Calcutta Trams, CESC, NTPC & SAIL, ……..

…

Reliable services **-** Commissioning , Corrective & Preventive Maintenance , Emergency expert Support , Safety

Upgrades to Machinery, Chip Level System Repairing .with controlling of physical and electrical parameters, highly

important for quality control to minimize breakdown, higher productivity and higher plant efficiency to improve profit level our

expertise and supports help to improve productivity with quality. Continuous improvement by implementing Plan-Do- Check-

Action and Monitoring machine status & problems to reduce machine waste and delay .

***** We undertake maintenance contract.

*We have very good localized service network hence not to worry for service at any part of India.

*We undertake to conduct detailed energy audit programme to reap the befits of latest energy efficient technologies and techniques that ultimately cut down the production cost tremendously.

…

THANKING YOU

FOR Technosoft Consultancy & Services

R. SHAH (9230056795)

Please visit : www.tcskolkata.com

Price of VFD and Electric Motors of M/s Kirloskar Electric. The motors are available with M/s Industrial Supply Syndicate, 54 Ezra Street, Kolkata – 700001. Phone: 2235 6676. Fax: 30222923.

PP= (X+Y)& VAT

FREIGHT&INSURENCE-TO UR A/C

X		Y(VFD MODULE)
3,450	0.75kw-	11,500.00
4,025	1.5kw-	12,650.00
4,600	2.2kw-	18,400.00
5,175	3.7kw-	21,850.00
5,750	5.5kw-	29,900.00
10,350	7.5kw-	35,650.00
11,500	11kw-	46,000.00
16,100	15kw-	52,900.00
17,250	18.5kw-	63,250.00
18,400	22kw-	65,550.00
25,300	30kw-	1,01,200.00
28,750	37kw-	1,15,000.00
34,500	45kw-	1,38,000.00
	55kw-	1,49,500.00
	75kw-	2,07,000.00
	90kw-	2,30,000.00
	110kw-	2,53,000.00
	0.4kw -	8,050.00
	0.75kw-	8,625.00
	1.5kw -	12,650.00
	2.2kw -	16,100.00

VVVF DRIVE PANEL ---POWDER COATED ENCLOSURE (FLOOR STANDING / WALL-MOUNTING) WITH FILTER-FITTED VENTILATOR , HOUSING FOLLOWING ACCESSORIES : -

*DRIVE MODULE (KECL MAKE) SINGLE /MULTIPLE UNITS.

* NECESSARY PROTECTORS (INPUT LINE ISOLATOR SWITCH / SEMI CONDUCTOR FUSE / MCB / MCCB , AC REACTOR (INPUT-OUTPUT), DC.REACTOR (INBUILT or EXTERNAL), CV.FANS, ISOLATED TRANSFORMER FOR LOGIC CONTROL-CKT., INDICATORS, MONITORS & CV FANS)

* OPERATIONAL FEATURES -- START , STOP , SPEED-SET (RAISE-LOWER) , FLT-RST, FWD-REV/ IND.-GRP/ PANEL-REMOTE/ MAN-AUTO MODE (COMPATIBLE INTERFACE FOR DCS / PLC / HMI)

* INDICATORS AND DIGITAL MONITORS FOR SUPPLY & SYSTEM STATUS , PRE-WARNING OVER-LOAD-ALARM TO AVOID TROUBLE.

*REMOTE CONTROL PENDENT/ DESK---OPERATOR BUTTONS, INDICATORS AND DIGITAL MONITORS FOR SYSTEM STATUS.

*VVFD BYPASS FACILITY WITH DOL / STAR-DELTA

*DYNAMIC BRAKING FACILITY.

*PUMP OPERATION CONTROLS (CONSTANT WATER SUPPLY PRESSURE, WATER LEVEL ,.....)

AMBETRONICS™
AN ISO 9001 : 2000 COMPANY

Ambetronics Engineers Pvt. Ltd.

Manufacturers of Process Control & Gas Detection Instruments & Automation System Integrator

17-B, Tarun Industrial Estate, Mogra Pada, New Nagardas Road, Andheri (East), Mumbai - 400069, India.
Tel.: +91-22-66995525, 28371143 • Fax: +91-22-28226570 • E-mail: sales@ambetronics.com • Web: www.ambetronics.com

MPSM (Energy Management)
Secretary AEE India Chapter & Energy Club
IISWBM, Management House
College Square West, Kolkata - 700 073, INDIA

Ref. : AEPL/PLD
Date : 22nd nov2010

Tel. : 94331 53009; Fax 033 22413975 (pp)
NOTE : pktiwari@beenet.in

Kind Attn. : **Mr. B K Choudhury, PhD (IIT)**

Sub. : **Your requirement of O2 analyzer.**

Dear Sir,

This refers to your email enquiry regarding above subject requirement. Thanks for the same.

We are a leading **ISO 9001:2000** certified company & reliable source with vast experience in the field of **Portable Gas detectors, Fixed type Online Gas Detection Systems & Pollution Monitoring Systems** providing standard and customized solutions for the safety monitoring against gas leak hazards for any plant / establishment / equipments.

We have proven professional expertise to execute the job on Turn-Key basis from design to commissioning with an efficient SERVICE AFTER SALES base. We undertake **Calibration Services** & **Annual Maintenance Contract** of all Indian / Imported Gas Detector, Analyzer and Transmitter.

Referring to your present requirement, we are pleased to submit our offer as below:

- **O2 analyzer**

We have some list of our satisfied user clients including such reputed names as **INDORAMA, GARDEN SILK, IOCL, POLLAD** and many more…

We are enclosing herewith relevant catalogue of the offered model.

Trust, you would find our enclosed quotation in order and look forward to the pleasure of receiving your valued order. Should you need any further clarification / information please feels free to get in touch with us.

Yours truly,
For **AMBETRONICS ENGINEERS PVT. LTD.**

Mr. Jay Mohan Jha
Mo: 09320657646
Encl.: ***Quotation***

AMBETRONICS™
AN ISO 9001 : 2000 COMPANY

Ambetronics Engineers Pvt. Ltd.

Manufacturers of Process Control & Gas Detection Instruments & Automation System Integrator

17-B, Tarun Industrial Estate, Mogra Pada, New Nagardas Road, Andheri (East), Mumbai - 400069, India.
Tel.: +91-22-66995525, 28371143 • Fax: +91-22-28226570 • E-mail: sales@ambetronics.com • Web: www.ambetronics.com

MK/AM/02 REV.:1.1
w.e.f.01/072008

QUATATION

Client : **Energy Management**
Ref. : **By phone, mail** Date : **22nd nov, 2010**

Sr. No.	Description	Qty.	Unit Price In Rs.	Amount In Rs.
1.	Lambda Probe LS 2-K, semi automatic calibration, Length: 500 mm **(ORDER CODE NO- 650R2030)**	1NO	159600.00	159600.00
2.	LT2 IN WALL MOUNTING CASE IN FOLLOWING VARIANT: FOR PROBE: LAMBDA-PROBE LS2 TYPE: SEMI AUTOMATIC CALIBRATION **DISPLAY: 657R0831/ R0833 INTERNAL** PRESSURE SENSOR: ABSOLUT & DIFFERENCE PRESSURE ANALOGUE OUTPUT 1: 657R0050 4...20mA ANALOGUE OUTPUT 2: WITHOUT ANALOGUE OUTPUT 3: WITHOUT ANALOGUE OUTPUT4: WITHOUT ANALOGUE INPUT 1: DIFFERENCE PRESSURE ANALOGUE INPUT 2: ABSOLUTE PRESSURE ANALOGUE INPUT 3: WITHOUT ANALOGUE INPUT 4: WITHOUT RM / LI / CONTROLLER / LOAD: WITHOUT EFFICIENCY: WITHOUT SUPPLY VOLTAGE: 230VAC REFERENCE AIR PUMP: WITHOUT CASE HEATING: WITHOUT CO-MONITORING / CONTROLLING: WITHOUT CALCULATIONS: WITHOUT LANGUAGE: ENGLISH/GERMAN SPECIAL CONFIGURATION: WITHOUT **(ORDER CODE NO- 657R102)**	1NO	283300.00	283300.00
	Grand Total			**442900.00**

Pump unit for reference air (20.96%) only
Necessary, if there is no instrument air available at the plant.

RUPEES: four lakh forty two thousands nine hundred only.

For **AMBETRONICS ENGINEERS PVT. LTD.**

Mr. Jay Mohan Jha
TEL.: 022-66995525, 26/ 28371143
FAX: 022-28226570, mob : 09320657646
EMAIL.: lamtec@ambetronics.com

AMBETRONICS™
AN ISO 9001 : 2000 COMPANY

Ambetronics Engineers Pvt. Ltd.

Manufacturers of Process Control & Gas Detection Instruments & Automation System Integrator

17-B, Tarun Industrial Estate, Mogra Pada, New Nagardas Road, Andheri (East), Mumbai - 400069, India.
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MK/AM/02 REV.:1.1
w.e.f.01/072008

COMMERCIAL TERMS & CONDITIONS

1	PRICE	:	The price indicated is for supply of material ex-factory basis. Packing, Forwarding Freight, Insurance, Installation & commissioning shall be Extra to your account.
2	TAXES	:	12.5% VAT for instrument. 4% VAT for software in Maharashatra. CST 2% against form 'C' out of Maharashatra
3	SERVICE TAX	:	10.3% SERVICE Tax for calibration/ Installation/ Commissioning/ Repairing.
4	PACKAGING	:	Not applicable if you pick up from our factory in Andheri, (Mumbai). 1% for Wooden Packing charges shall be on order value for Transport, Export purpose.
5	FREIGHT	:	2% OR At actual borne by PURCHASER; Send your transport details.
6	INSURANCE	:	Goods will be dispatched only at owner's risk and if you want the goods to be insured the insurance charges to be born by you.
7	PAYMENT TERM	:	50% with PO & 50% against Proforma Invoice through DD.
8	BANK DETAILS	:	If the material is through bank then all the bank charges will be born by you. Please inform us complete postal address of your bankers. Our bank details are BANK OF INDIA, S.V.RD., ANDHERI (W), MUMBAI – 400 058
9	DELIVERY	:	3/4 weeks From the date of your Commercially & Technically clear purchase order.
10	INSPECTION	:	The goods will be offered for inspection at our factory. Please intimate us the date of inspection along with the order copy. Otherwise, we will assume that inspection has been waived & we will dispatch the material.
11	VALIDITY	:	60 days from date of submission.
12	WARRANTY	:	12 months from the date of delivery of the instrument against faulty material or manufacturing defects. (The Warranty does not include site support / repairs)
13	SERVICE AFTER SALES	:	The service support in warranty period & after warranty period is offered from our factory at Mumbai. In case if the service support is required at the site the same will be taken up on the chargeable basis.
14	DOCUMENTS SUPPLY ALOGN WITH MATERIAL	:	Operating Instrument Manual, Test & Calibration Certificate, Warranty Certificate will submit you along with the ordered material on dispatch.
	NOTE	:	Delivery & Quotation validity are subject to force Major Clauses (Government Actions, War, Disasters, Economy / Exchange, Crisis Etc.)

Annexure 5

Financial schemes available with local banks for improving energy efficiency in cluster

1. Credit linked capital Subsidy scheme(CLCSS)

Under this scheme, the ministry of MSME is providing subsidy to upgrade technology (Machinery/plant equipments). Subsidy limit per unit is ₹ 15 lakh or 15% of investment in eligible machinery/Plant equipments whichever is lower. For more details of the scheme visit:

www.laghu-udyog.com/scheme/sccredit.htm

2. SIDBI Financing Scheme for Energy Saving Projects in MSME sector under JICA Line of Credit

The Japan International Corporation Agency (JICA) has extended a line of credit to SIDBI for financing Energy Saving projects in Micro, Small and Medium Enterprises (MSMEs). This project is expected to encourage MSME units to undertake energy saving investment in plant and machinery to reduce energy consumption, enhance energy efficiency, reduce CO_2 emissions, and improve the profitability of units in the long run.

Eligible Sub Projects/ Energy Saving Equipment List under JICA line of Credit:

- Acquisition (including lease and rental) of energy saving equipments, including newly installing, remodeling and upgrading of those existing
- Replacement of obsolete equipments and/or introduction of additional equipment which would improve performance
- Equipments/ Machinery that meets energy performance standards/Acts
- Introduction of equipments that utilize alternative energy sources such as natural gas, renewable energy etc., instead of fossil fuels such as Oil and Coal etc.
- Clean Development Mechanism (CDM) projects at cluster level that involves change in process and technologies as a whole, duly supported by technical consultancy will be eligible for coverage.

Financial parameters:

The financial parameters for appraising the project are:

Parameter	Norms
Minimum Assistance	Rs. 10 lakh
Minimum promoters contribution	25% for existing units; 33% for new units
Interest rate	The project expenditure eligible for coverage under the line will carry a rate of interest rate of 9.5-10% p.a
Upfront fee	Nonrefundable upfront fee of 1% of sanctioned loan plus applicable service tax
Repayment period	Need based. Normally the repayment period does not extend beyond 7 years. However, a longer repayment period of more than 7 years can be considered under the line if necessary

Eligibility criteria for units (Direct assistance):

- Existing units should have satisfactory track record of past performance and sound financial position.
- Projects will be screened as per Energy Saving List, which is available in SIDBI website.
- Units should have minimum investment grade rating of SIDBI.
- Projects which may result environmental impacts and negative social impacts are also not eligible under this scheme.

For further details eligible energy saving equipments/machinery, projects can be financed under this scheme and details of scheme, please contact the nearest SIDBI branch office or refer to SIDBI website (**www.sidbi.in**)

3. Scheme for Financing Energy Efficiency Projects

PURPOSE:

- Financing SMEs for acquisition of equipments, services and adopting measures for enhancement of energy efficiency/conservation of energy.

ELIGIBILITY

- SME units financed by bank as also other units desirous of shifting their account to Bank of Baroda.

LIMIT:

- Upto 75% of the total project cost, subject to maximum of Rs. 1/- crore. (Minimum amount of loan Rs. 5/- Lakhs).

Project cost may include the following:

- Cost of acquisition/modification/renovation of equipment/software.
- Cost of alterations to existing machinery.
- Cost of structural / layout changes.
- Cost of energy audit/consultancy.
- Preparation of Detailed Project Report (DPR).

RATE OF INTEREST:

- Bank's BPLR from time to time.

REPAYMENT:

- Maximum 5 years, including moratorium, if any.

SECURITY:

a. For Sole Banking Accounts: Extension of first charge on all fixed assets.

b. For Consortium/Multiple Banking Accounts: first charge on equipments acquired out of loan and collateral, if any, with the total security coverage being not less than 1.25.

Grant from IREDA:

- IRDEA, at present, gives a grant of Rs. 25,000/- for projects costing Rs. 1/- crore or below to meet partial cost of Energy Audit. This grant is available for the first 100 projects (SME Sectors only) approved by them.

Annexure 6

MESSAGES FROM INDUSTRY ASSOCIATIONS

HCCI **Howrah Chamber of Commerce & Industry**
'Laxmi Niketan', 243, G. T. Road (N), 1st Floor, Liluah, Howrah-711 204, West Bengal, India
Phone : 033-2654 3314, 033-2654 3727, Fax : 033-2654 3314
e-mail : howrahchamber@gmail.com, bengalhcci@gmail.com, Website : www.howrahchamber.com

Ref. No. Hcci/BCS/1119-2010-11 Date. 18/11/10

Dr. B.K.Choudhury
Principal Investigator
BEE-SME Programme in Howrah (Galvanising & Wire Drawing) Cluster
Associate Professor Energy Management of MPSM Deptt.
Indian Institute of Social Welfare & Business Management (IISWBM))
Management House, College Square West
Kolkata-700073

Dear Dr. Choudhury,

It gives me great pleasure introducing this Energy Saving Programme initiated by BEE / SME and IISWBM , Kolkata, a reputed inistitute of the country, particularly for Galvanizing / Wire-drawing Industy based in Howrah in collaboration with Howrah Chamber of Commerce & Industry and FOSMI.

Power / energy is scarce commodity in a growing economy and due to increase in the cost of fossil fuel and depleting source of non renewable fuel i.e. Gas and Oil, the cost of power is becoming prohibitive. It is also a social crime to waste energy and the Micro, Small entrepreneurs being responsible citizens of the society owe it to themselves and others to take advantage of the scheme which will enable them to use energy more efficiently. This not only will help the MSMEs to save energy and reduce the costs of production, thus maximizing the benefit.

The HCCI is very much engaged in creating awareness among our member entrepreneurs and has requested them to take part in energy saving programme, be it Rolling Mills, Foundry or any other power consuming industry for the last few years by organizing interactive sessions with Energy Experts. It is worth mentioning here that this programme for employees, supervisors and entrepreneurs is being conducted to familarize the stakeholders with the energy saving functions at different stages of production.

I also thank BEE/ IISWBM and its officials and the Micro, Small and Medium Entrepreneurs who are participating the programme with a request that they apply deligently the knowledge gained from this project in their own units.

Your sincerely,

(Sankar Kumar Sanyal)
President

FOSMI

FEDERATION OF SMALL & MEDIUM INDUSTRIES, W.B.

23, R. N. MUKHERJEE ROAD, KOLKATA - 700 001

F-47

✆ : (O) 033-2248-5114
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Biswanath Bhattacharya
President

Message for the MANUAL ON ENERGY CONSERVATION IN GALVANIZING & WIRE – DRAWING SECTOR IN HOWRAH CLUSTER

It is an honour to be associated with a programme like the one being organized today. Conservation of energy is the crying need not only of the hour but of the future. Energy is at a premium and is becoming more so every day. Simultaneously with the search for new energy sources emphasis should be given to plugging wastage of energy. That is where energy audit comes in. The Bureau of Energy Efficiency has selected two sectors viz. Galvanizing and Wire Drawing for the time being for energy audit. All units should cooperate with regard to the energy audit for their own benefit in terms of energy saving as well as the resulting financial gain. We take this opportunity to most cordially thank IISWBM for taking such significant initiative for the project to succeed.

BISWANATH BHATTACHARYA
PRESIDENT, FOSMI

EFF I

MHLP 1A
Revision-3

Energy Efficient Motors

Totally Enclosed Fan Cooled (TEFC) Squirrel Cage Motors - Foot Mounted (B3)
Horizontal Foot mounted Induction motors, continuously rated suitable for operation on 415 Volts ± 10%, 3 Phase, 50 Hz ± 5%, AC Supply with Class 'F' insulation and temperature rise limited to Class 'B', for an ambient of 50°C and altitude less than 1000m above MSL, IP 55 Protection and conforming to IS 325:1996 / IS 12615:1999

OUTPUT				4 POLE - 1500 RPM	
Kw	Hp	Frame	Cat. Ref.	List Price (Rs)	Excise Duty (Rs)
0.06	0.08	MHHE56ZAA4	MHHETAS40X06	7,078	328
0.09	0.12	MHHE56ZBA4	MHHETAS40X09	7,122	330
0.12	0.16	MHHE63ZAA4	MHHETBS40X12	7,236	335
0.18	0.25	MHHE63ZBA4	MHHETBS40X18	7,445	345
0.25	0.33	MHHE71ZAA4	MHHETCS40X25	7,622	353
0.37	0.50	MHHE71ZBA4	MHHETCS40X37	7,894	366
0.55	0.75	MHHE80ZAA4	MHHETDS40X55	9,209	427
0.75	1.00	MHHE80ZBA4	MHHETDS40X75	9,197	426
1.1	1.50	MHHE90SAA4	MHCETES401X1	10,645	493
1.5	2.00	MHHE90LBA4	MHCETFS401X5	11,625	539
2.2	3.00	MHHE100LAA4	MHCETGS402X2	15,446	716
3.7	5.00	MHHE112MAA4	MHCETHS403X7	19,829	919
5.5	7.50	MHHE132SZA4	MHCETIS405X5	27,299	1,265
7.5	10.00	MHHE132MZA4	MHCETJS407X5	31,840	1,476
9.3	12.50	MHHE160MYA4	MHCETKS409X3	50,663	2,348
11	15.00	MHHE160MXA4	MHCETKS40011	51,030	2,365
15	20.00	MHHE160LXA4	MHCETLS40015	63,377	2,938
18.5	25.00	MHHE180MXG4	MHCETMS4018X5	85,716	3,973
22	30.00	MHHE180LXG4	MHCETNS40022	91,234	4,229
30	40.00	MHHE200LNG4	MHCETOS40030	1,23,396	5,719
37	50.00	MHHE225SN4	MHCETPS40037	1,58,534	7,348
45	60.00	MHHE225MN4	MHCETQS40045	1,92,172	8,907
55	75.00	MHHE250MN4	MHCETRS40055	2,64,179	12,245
75	100.00	MHHE280ST4	MHCETSS40075	3,38,407	15,685
90	125.00	MHHE280MT4	MHCETTS40090	3,92,101	18,174
110	150.00	MHHE315SYE4	MHCETUS40110	4,49,202	20,820
132	180.00	MHHE315MYE4	MHCETVS40132	5,28,858	24,513
160	220.00	MHHE315MZE4	MHCETVS40160	5,90,282	27,360
200	270.00	MHHE315LZE4	MHCETWS40200	7,53,363	34,918
225	300.00	MHHE355MA4	MHCETYS40225	7,70,853	35,729
250	340.00	MHHE355MB4	MHCETYS40250	7,93,612	36,784
275	370.00	MHHE355MC4	MHCETYS40275	8,40,725	38,968
315	425.00	MHHE355LA4	MHCETZS40315	9,50,400	44,051
335	450.00	MHHE355LB4	MHCETZS40335	10,28,379	47,665
350	470.00	MHHE355LC4	MHCETZS40350	12,25,400	56,797

Note: Havells standard motors in frame 315 and above are at no extra cost

Intermediate Ratings (Class F insulation with temperature rise limited to Class F)					
OUTPUT				4 POLE - 1500 RPM	
Kw	Hp	Frame	Cat. Ref.	List Price (Rs)	Excise Duty (Rs)
0.25*	0.33	MHHE63ZCA4	MHHETBS40X25	7,527	349
0.55	0.75	MHHE71ZCA4	MHHETCS40X55	9,019	418
1.1	1.50	MHHE80ZCA4	MHHETDS401X1	10,449	484
1.8	2.50	MHHE90LCA4	MHCETFS401X8	13,194	612
2.2	3.00	MHHE90LDA4	MHCETFS402X2	15,098	700
3.0*	4.00	MHHE100LBA4	MHCETGS40003	17,090	792
3.7	5.00	MHHE100LCA4	MHCETGS403X7	19,139	887
5.5	7.50	MHHE112MBA4	MHCETHS405X5	27,375	1,269
9.3	12.50	MHHE132MRA4	MHCETJS409X3	45,920	2,128
11	15.00	MHHE132MTA4	MHCETJS40011	50,069	2,321
30	40.00	MHHE180LRG4	MHCETNS40030	1,20,788	5,599
37	50.00	MHHE200LFG4	MHCETOS40037	1,58,322	7,338
75	100.00	MHHE250MK4	MHCETRS40075	3,37,886	15,661

** Class F insulation with temperature rise limited to Class B*

HAVELLS

Havells Lafert Motors
Price List w.e.f. 1st April 2010
Manufactured with Technology from AEG Electric Motors

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