Energy Conservation for the Philippine Steel and Iron Industries: Case Studies

Loreto C. Carasi

Philippine Council for Industry and Energy Research and Development

Department of Science and Technology

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OUTLINE

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- PCIERD EE & C Initiatives
- EE&C for the Philippine Steel and Iron Industry
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DEPARTMENT OF SCIENCE AND TECHNOLOGY (DOST)

Premier science and technology body

Mandates:

- Central direction, leadership & coordination
- Policy, program & project formulation
- Councils, R&D Institutes, Service Institutes, Regional Offices

DOST Sectoral Planning Councils

- **Philippine Council for Industry and Energy Research and Development (PCIERD)**
- Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD)
- Philippine Council for Aquatic and Marine Research and Development (PCAMRD)
- Philippine Council for Advanced Science and Technology Research and Development (PCASTRD)
- Philippine Council for Health Research and Development (PCHRD)

- R&D
- INSTITUTION BUILDING
- MANPOWER DEV'T AND SCHOLARSHIP
- SEMINARS AND CONFERENCES
- TECHNOLOGY TRANSFER
- POLICY DIRECTIONS

PCIERD Mandates

- Industry & energy policies, strategies, plans and programs
- Fund programming & allocation
- Project & program monitoring
- External fund generation

Services Offered by PCIERD

- Provides Grants-in-Aid (GIA)
- Grants applied S&T scholarships
- Disseminates & promotes S&T information
- Supports scientific & technological services

SECTORAL COVERAGE

- FOOD & FEED
- PROCESS /CHEMICAL
- TEXTILE AND GARMENTS
- MINING & MINERALS
- METALS & ENGINEERING
- ENERGY
- TRANSPORTATION
- CONSTRUCTION
- ENVIRONMEN
- DISASTER AND MANAGEMENT

PCIERD EE & C Initiatives

- **Capacity Building**
  - **Establish Core of Experts in the Region**
  - **Factory Energy Audit on SMEs**
  - **GAP Funded**
  - **PCIERD Funded**
- **Infrastructure Support**
  - **Provision of equipment**
- **Policy Support**
  - **Report to DOE the DOST's Energy Savings**
  - **Establishment of Vehicle Research and Testing Facility**
  - **Promotion of Biofuels**

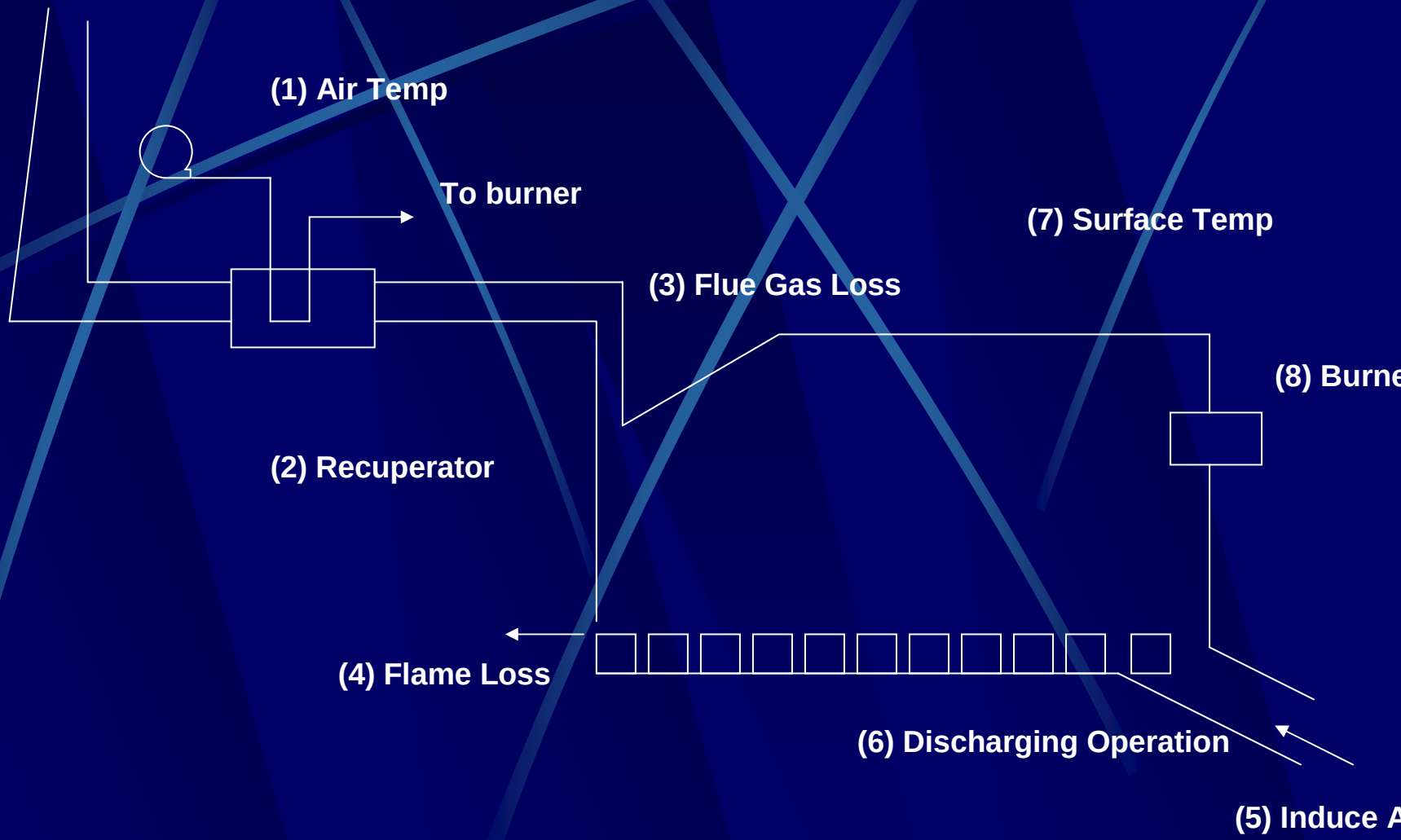
EE & C for the Philippine Steel and Iron Industry

- **Objectives of the program:**
  - To provide technological exchange of information and expertise
  - To conduct human resources development
  - To conduct energy audit and technical assessment on the selected industries
  - To establish network and linkages among the local and Japanese industries

Company A

- **Products**
  - Plain and deformed steel bars and rods for concrete reinforcement
- **Production capacity**
  - 250,000MT per year
- **Total Energy consumption per year**
  - Electricity
    - 25 Mw-hr
  - Fuels
    - 9,500 Kilioliters
- **Number of employees**
  - 147
- **Location**
  - Metro Manila

Furnace


(1) Air Temp
To burner
(7) Surface Temp
(3) Flue Gas Loss
(8) Burne
(2) Recuperator
(4) Flame Loss
(6) Discharging Operation
(5) Induce A

Findings:

1. Preheated Air : Defective instrument to grasp the preheated air temperature
2. Recuperator: Defective recuperator tubes
3. Waste Gas Loss: Temperature of outlet is 798 ^{o}C
   % Oxygen in flue gas is 3.8%
4. Heat Loss from Charging Door: Temp. of gas from charging door is 691 ^{o}C
   Open space is measured at 0.92 m^2
5. Induced Air from Discharging Door: Amount of air is 4,900 m^3 per hr
6. Discharging Operation: No problem
7. Heat Loss from Surface: Temperature of furnace shell external surfaces (roof and side walls) is 90-100^{o}C
8. Burner: Straight type burners is used

Cooling System (Pumps)

- Skid Furnace
  - Operates well
- Mill
  - Motor loading is low
- Quench
  - Motor loading is low

Compressors

- Loading and Unloading time : Ok
- Load requirements vs. Delivery capacity: Ok
- Discharge Pressure vs. Required Pressure at the User Side : Decrease the discharge pressure gradually
- Leakage Along Supply Line
- Draining of Moisture

Implemented Measures

Furnace:

- Instrument wirings on the control panel were modified to get readings of pre-heated air
- Repair of recuperator to eliminate air leakage
- Installation of “heat curtain” at the charging door of furnace to minimized heat loss (Later replaced with sliding-plate type)
- Reduction of induced air from discharging door
- Improvement of burner combustion efficiency
- Minimizing heat loss from furnace
- Improvement of furnace data monitoring

Implemented Measures

Pumps/Blowers:

- Improvement of combustion blower motor loading
  - The 100 HP motor for combustion blower was replaced with a 75 HP motor. The motor loading was increased from 70% to 95%.

- Repair of Rolling Mill Circulating Pump
  - The impeller was replaced and the seal ring was repaired. Motor loading was increased from 70% to 95%.

Air Compressors:

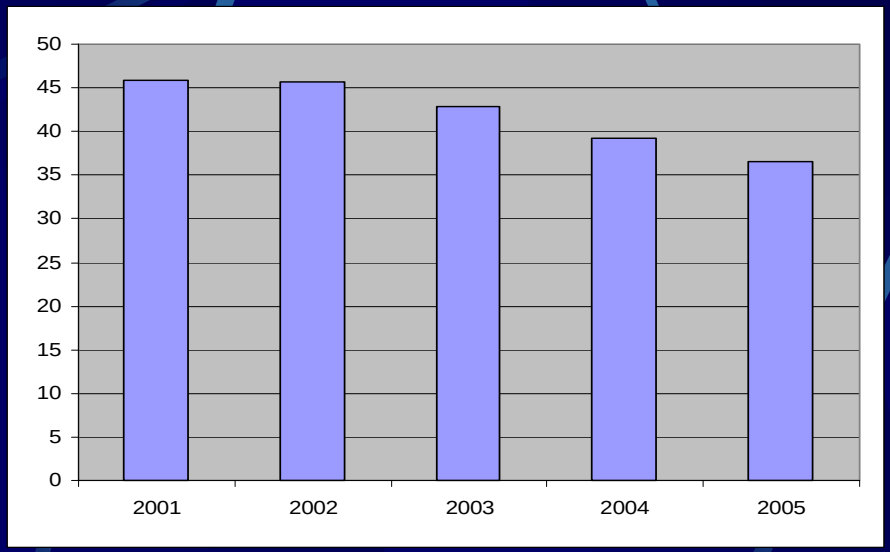
- Minimized air leakage in the system
  - Conduct leak test for the air supply
  - Correction of air leakages in the system is a continuing program

Mill bay Lighting

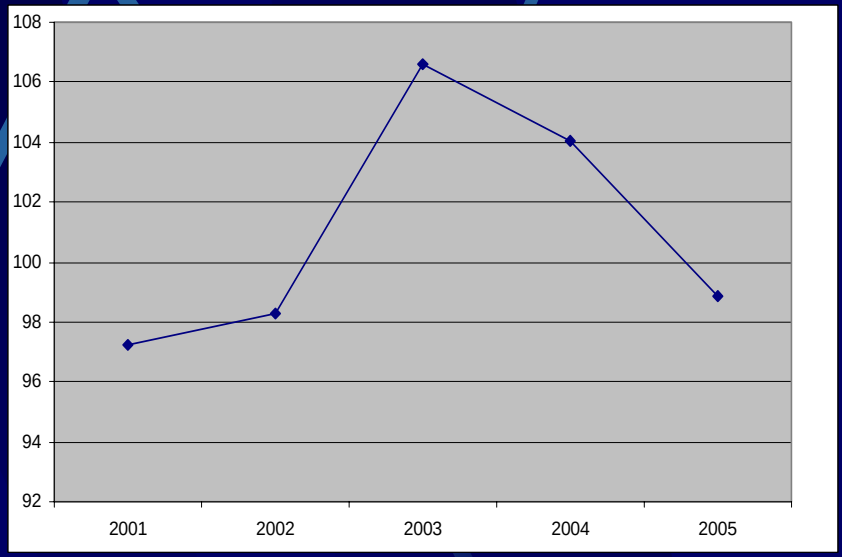
- Used/installed skylights at strategic locations inside the mill to enhance illumination.

Fuel and Power Consumption Trends

Power



Electricity



	2001	2002	2003	2004	2005
Fuel, Lit/ton	45.88	45.77	42.9	39.26	36.51
Power, Kw-hr/ton	97.22	98.28	106.58	104.04	98.87

Amount of Energy (2004)

Particular	Energy Savings		
	Lit/ton	%	Savings (Peso)
Reduction in Fuel	3.64	8.48	4.167 M
	Kw-hr/ton	%	Savings (Peso)
Reduction in Power	2.54	2.38	1.418 M
TOTAL ENERGY SAVINGS			**5.585 M**

Amount of Energy (2005)

Particular	Energy Savings		
	Lit/ton	%	Savings (Peso)
Reduction in Fuel	2.75	7.0	3.4M
	Kw-hr/ton	%	Savings (Peso)
Reduction in Power	5.17	4.97	2.8 M
TOTAL ENERGY SAVINGS			**6.2M**

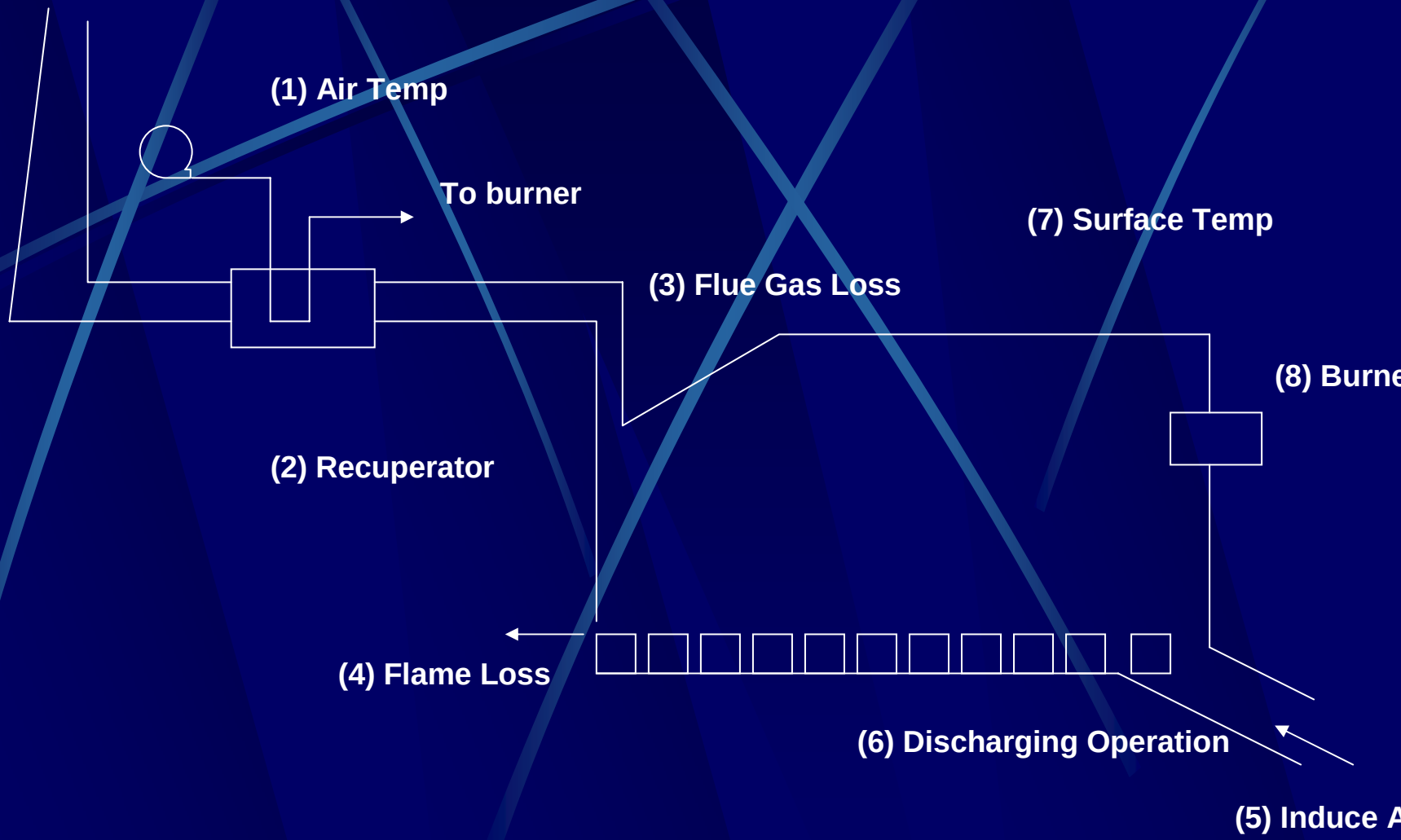
Plans

- Lengthen the heating zone of the furnace to reduce flue gas temperature
- Additional insulation on the furnace shell outside surfaces
- Use of inverter control for the TTL process pumps
- Replacement of straight-type burners to swirl type burners
- Close Monitoring of plant power factor to ensure PF is always at its optimum
- Recycling of used oil and grease
- Provision of pneumatic lubricator
- Continue the checking/repair of air leakages in the plant

Company B

- **Products**
  - Deformed bars
- **Production Capacity**
  - 121,337.22 MT per year
- **Annual Energy Consumption (average)**
  - Electricity = 13.4 MWH
  - Fuels = 4,114 kiloliters
- **Number of Employees**
  - 185
- **Location**
  - Metro Manila

Furnace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(5) Induce A

Findings:

Preheated Air Temp : Low @ 224^{o}C

Recuperator: Check leakage

Waste Gas Loss: Waste gas temperature at recuperatror inlet is quite low at 665^{o}C

Heat Loss from Charging Door: Temp. of gas from charging door is 680 ^{o}C
Open space is measured at 0.92 m^{2}

Induced Air from Discharging Door: Amount of air is 1,100 m^{3} per hr

Discharging Operation: 2-3 billets are discharged together, and the 2nd and 3rd billets cannot be rolled coz its temp. has lowered and thus require further heating

Heat Loss from Surface: Temperature of furnace shell external surfaces (Ceiling: 100-130, Side: 85-95^{o}C

Burner: Straight type burners is used

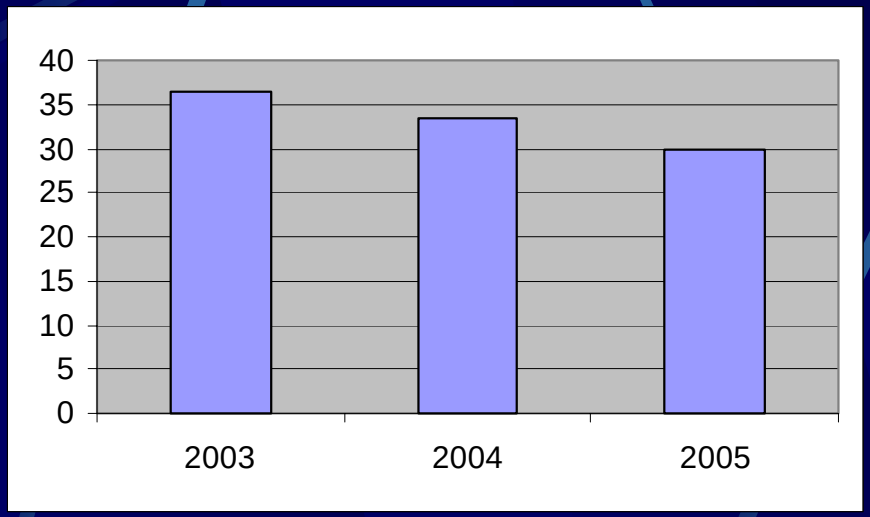
Furnace Scale Generation: The ave. concentration for waste gas oxygen concentra is 1.7%

Implemented Measures

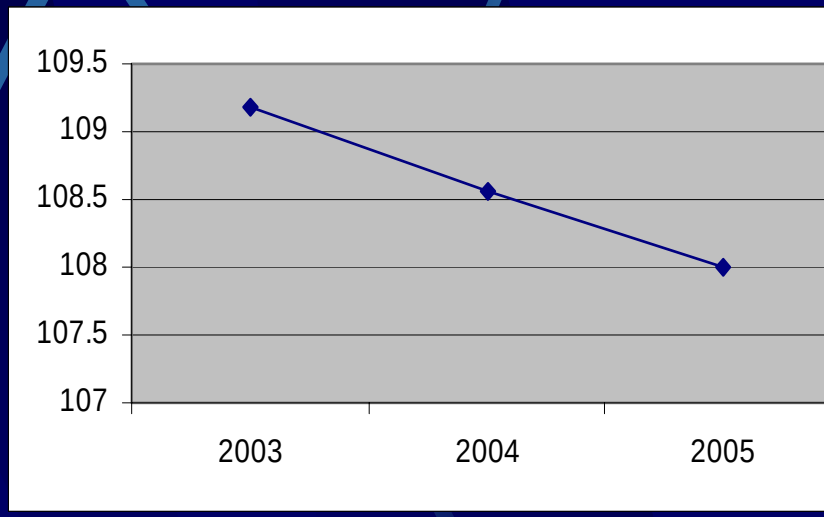
- Replacement of existing recuperator
- Installation of insulation curtain at the inlet door of the furnace
- Reduce opening time of billet discharge door
- Reduction of waste gas oxygen concentration from 1.7% to 1.3%
- Raising the furnace pressure setting
- Optimization of Billet Reheating Furnace
- Application of cladding insulation on the oil pipe lines
- Increase setting of oil heaters at the main line (soaking and heating zone) from 90^{o}C to 110^{o}C
- Set-up energy conservation group

Fuel and Power Consumption Trends

Power



Electricity



	2003	2004	2005
Fuel, Lit/ton	36.39	33.45	30
Power, Kw-hr/ton	109.19	108.56	108

Amount of Energy (2004)

Particular	Energy Savings		
	Lit/ton	%	Savings (Peso)
Reduction in Fuel	2.94	8.08	4.206M
	Kw-hr/ton	%	Savings (Peso)
Reduction in Power	0.63	0.51	0.444M
TOTAL ENERGY SAVINGS			**4.65 M**

Amount of Energy (2005)

Particular	Energy Savings		
	Lit/ton	%	Savings (Peso)
Reduction in Fuel	3.45	10.31	5.074M
Reduction in Power	Kw-hr/ton	%	Savings (Peso)
	0.56	0.52	0.377 M
TOTAL ENERGY SAVINGS			5.451M

Plans

- BRF heat conservation (charging and discharging side)
- BRF waste gas temperature monitor and control
- Use of stand alone electric furnace in preheating pre-determined steel
- Demand KW monitor and control
- Make-up water volume monitor and control
- Compressed air leakage monitor and control

Company C

- **Products**
  - Galvanized and Pre-painted Sheets/Coils
- **Production capacity per year (average)**
  - **Continuous Galvanizing Line (CGL)**
    - 34,703 tons
  - **Color Coating Line (CCL)**
    - 27,588 tons
- **Total Energy Consumption (average)**
  - **Electricity**
    - **CGL**
      - 1,058 MWh per year
    - **CCL**
      - 845 MWh per year

Total Energy Consumption (average)

- **Fuel consumption per year**
  - **CGL**
    - Fuel Oil:577,728 liters
    - LPG: 256,513 kgs.
  - **CCL**
    - LPG: 492,170 kgs.

- **No. of employees**
  - 170

- **Location**
  - Laguna

Power and Electricity Consumption Trend

Continuous Galvanizing Line (CGL)

	2003	2004
Energy Consumption		
BFO/SFO, Liters	625,497	529,959
LPG, Kgs	290,349	222,678
Power, Kw-hr	1,196,234	920,634
Rate of Consumption		
BFO/SFO, Lit/ton	17.172	16.069
LPG, Kg/ton	7.971	6.752
Power, Kw-hr/ton	32.841	27.914

Power and Electricity Consumption Trend

Color Coating Line (CCL)

	2003	2004
Energy Consumption		
LPG, Kgs	576,477	407,863
Power, Kw-hr	954,965	734,896
Rate of Consumption		
LPG, Kg/ton	19.106	16.313
Power, Kw-hr/ton	31.650	29.393

Particulars	Energy Savings		
Reduction in Fuel	Kgs. per ton of product	% Savings	Savings (Peso)
LPG			
•CGL	1.219	15.3	1.327 M
•CCL	2.793	14.6	2.304 M
	Lits. per ton of product		
Bunker Oil			
•CGL	1.103	6	0.654 M
	KW-hr/ton		
Reduction in Power			
•CGL	4.927	15	1.075 M
•CCL	2.257	7.1	0.305 M
TOTAL			**5.665 M**

Implemented Measures

- System Improvement
  - Improved treading time from 5-6 minutes to 3 minutes
  - Installation of cartridge type coaters to reduce downtime in changing colors and replacing paint coater rolls
  - Installation of 12.5 MT overhead crane to handle bigger coil materials
  - Installation of horizontal direct fired LPG preheater
  - Change technology from zinc lead-lead-zinc hot dip galvanizing to a modified John Lysaght process
  - Installation o direct fired LPG coil heater
- Conduct study on peak kW
  - Reduced demand at CGL furnace
  - Reduced demand at CCL oven
- Improvement of power factor from 81% to 94%
- Improvement of light distribution at CCL

Plans

- Decommission boiler using BFO
- Shift of fuel materials from BFO to SFO
- Improve burner firing at LPG preheater
- Decommission air dryers, exhaust gas from LPG direct fired alkali heaters used as air dryers
- Decommission smoothener rolls drive of 7.5kW
- Waste heat recovery at LPG heaters and dryers
- Conduct efficiency tests in ovens and furnaces for temperature profiling

Common measures implemented

- Minimizing heat loss from furnace
- Improvement of burner efficiency
- Improvement of pump motor loading
- Minimized compressed air leakage

Common plans

- Heat conservation on the reheating furnace
- Waste gas temperature monitor and control
- Demand kW monitor and control
- Make-up water volume monitor and control
- Compressed air leakage monitor and control

Conclusion

- The participating factories shows positive response.
  - Recommended measures or areas of improvement suggested by the experts have been implemented and it was reported that there was a great improvement in plant efficiency and significant savings was realized.
  - Local skills were enhanced and they can now do energy audit by their own.
- The significance of Energy Conservation and Management has been recognized, which is evident to their new initiatives.
  - Setting-up of company's energy conservation targets
  - Creation of energy managers and auditors
  - Energy conservation are discussed during management meetings

Thank You

PCIERD Website

http://www.pcierd.dost.gov.ph