G-STEEL PUBLIC COMPANY LIMITED

COMPANY DESCRIPTION

G-STEEL Public Company Limited was founded by Dr. Somsak Leeswadtrkul, and is considered a leader and a pioneer of the Thai and Southeast Asian steel industry with more than 40 years of experience in hot rolled coils manufacturing.

The plant is located in Rayong, which is about 175 kilometers from Bangkok, Thailand. The grand opening of G -Steel was on 30 March 2000 with the support from the SSP Group and large end-users of hot rolled coils. The total investment to establish the company was US$1 billion. The plant obtained promotional privilege from Thailand's Board of Investment in 1996.

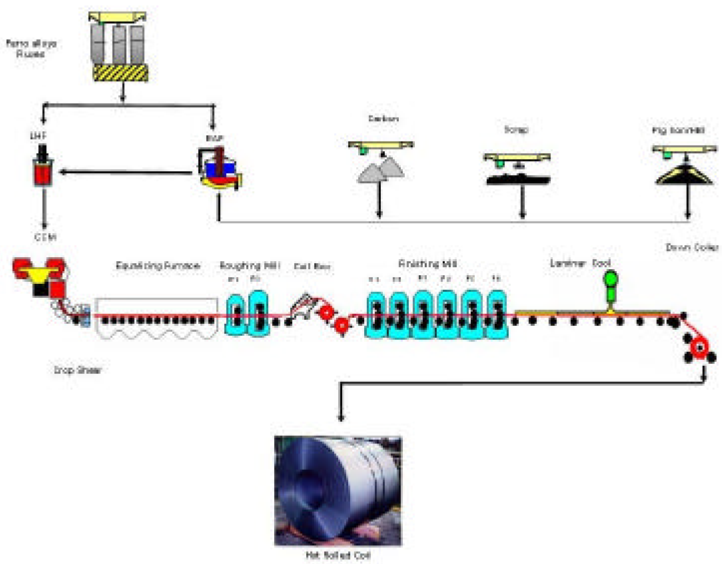
G-STEEL's plant is equipped with advanced and integrated technology at its liquid steel making, slab casting and hot rolling processes. This multi-phased steel plant operates at full production capacity of approximately 1.8 million tons of hot rolled coils (HRC) per year, meeting product quality specifications of domestic and international markets.

PROCESS DESCRIPTION

G-STEEL's plant is amongst the most advanced steel plants worldwide. The plant's "Compact" or "Mini mill" layout comprises of three basic integrated production processes:

- ***Steel Making:*** The first step is to melt a variety of metal scrap and other bearing materials, such as pig iron, with additives to produce clean steel. This process is carried out in two Electric Arc Furnaces (EAF) supplied by Mannesman Demag Huttentechnik, Germany and equipped with oxygen fuel burners, carbon injection system, and other equipments. The steel is further chemically refined to meet customer requirements in two Ladle Heating Furnaces (LHF).
- ***Continuous Casting:*** In the second step, the clean, refined and graded steel in liquid form is fed into a medium thickness continuous slab caster. The slab casting technology was supplied by Sumitomo Heavy Industries, Japan, and is in terms of quality and production cost superior to thin slab casters. The caster has the state-of-the-art features: liquid core reduction, start-stop sequence, mould level control, and break out prediction module. This allows G-STEEL to simplify the operator tasks of this complex process.
- ***Hot Rolling Mill:*** In the last step of the production process, the slab from caster is fed through a tunnel furnace, which maintains the slabs at required rolling temperature, to a continuous rolling mill. Mitsubishi, the world leader of heavy industries companies, supplied the mill. It consists of two roughing stands, mandrels, a coil box, and six finishing stands. The coil box installed between roughing and finishing mill optimizes the scrap requirement and improves the transfer temperature thereby reducing the power requirements. Other features include crown and shape control technologies, latest gauges and on roll grinding.

Figure 1: Hot Rolled Coils production process



G-Steel is committed to quality and environmental control:

- ***Quality Control:*** G-STEEL's objective is to consistently provide high quality products to meet customers' expectations as well as the industry's own stringent standards. This commitment is reflected by its ISO 9001:2000 accreditation, which in combination with world-class production technology ensures that customers get products of a reliable quality. ISO certification is also a major step towards fulfilling G-STEEL's vision which is to
  - Contribute to Thailand's future industrial growth through continuously adopting more environmentally friendly technology and professional management
  - Produce a wide range of steel products at competitive prices, thus reducing the need for Thai customers to buy products in foreign currencies, and earning foreign currency for Thailand through export of its products.
- ***Environmental Control:*** G-STEEL recognizes that industrial development will adversely affect the environment and therefore aims to use environmentally friendly technologies that use electricity and natural gas. G-STEEL also installed a bag filter to collect dust from the process and a wastewater treatment plant equipped with a Zero Discharge System to recycle the plant's wastewater in the production process. The Office of Environmental Planning and Policy approved the plants Environmental Impact Assessment (EIA) in 1996, but G-STEEL aims to continuously improve its environmental performance to national and international standards.

METHODOLOGY APPLICATION

The draft Company Energy Efficiency Methodology was used as a basis for the plant assessment to identify and implement options to reduce energy and other materials and wastes. Some of the interesting experiences are:

- ***Task 1d – Select focus areas***

The assessment at this plant was carried out by the plant's Team, the Thai facilitating organization TISTR, and an international consultant. Screened options for feasibility analysis were presented at a meeting with top management. Top management's feedback was that their priority area is the electric arc furnace because it is a major energy consumer, which was not selected as a focus area. Instead, focus areas including steam, compressed air and cooling towers had been selected partly because these were the consultant's areas of expertise rather than furnaces.

Lesson learnt: It is very important to ask top management what their priorities are before selecting focus areas.
Lesson learnt: It may be more effective to contract a consultant after the focus areas have been selected because then the company can search for specific expertise for the focus areas.

- ***Task 4b – Ranking feasible options for implementation***

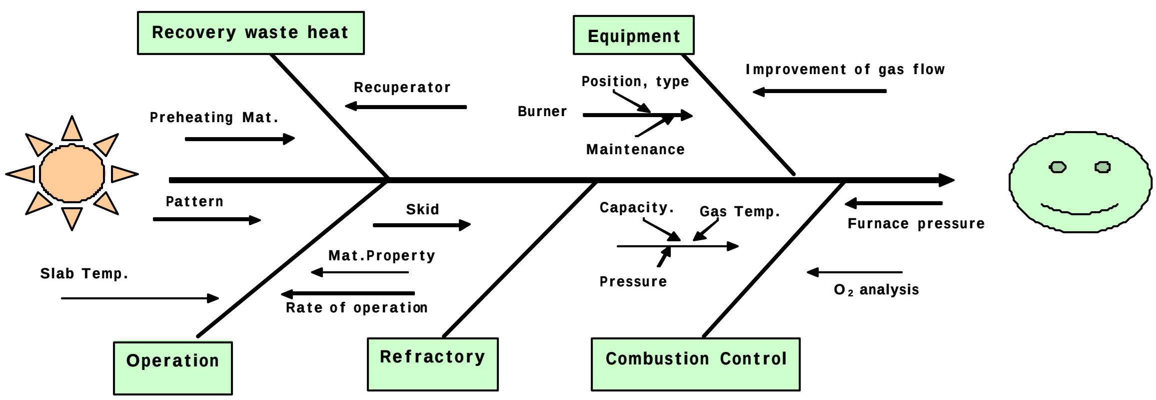
Steel manufacturing generates several types of wastes and emissions in large quantities. The company is also relatively close to residential areas. As a result, environmental permit requirements are quite strict. Because of this compliance with permit conditions and relationships with residents and local authorities were important criteria considered for the evaluation of options and ranking options for implementation.
Lesson learnt: External factors such as legislative requirements, relationships with government authorities and public image can be important criteria for selecting options for implementation.

- ***Task 5a – Implement options and monitor results***

The company implemented several options, but for the external facilitators it was difficult to obtain the results from the plant's Team. A meeting with the CEO of the company was organized to explain the need to obtain results to be able to write case studies for implemented options. With the CEO's support, the plant's Team had the permission to spend time to monitor and report results.
Lesson learnt: Top management support is important throughout the assessment, not only at the start.

- ***Task 5a – Implement options and monitor results***

The company used the "Fish Bone Diagram" to identify not only the causes but also the options to reduce natural gas consumption at the Tunnel Furnace. This now serves as an overview of the action plan for implementation.
Lesson learnt: The Fish Bone Diagram can also be used as an action plan with an overview of options to be implemented



- ***Step 6 – Continuous improvement***

The company implemented a staff motivation programme to increase the output and reduce electricity consumption in the electric arc furnace (EAF), as illustrated in the table below. The monthly costs savings are shared among employees, who either directly or indirectly contributed

to the savings, as a "one off " payment, which will be included in employees' monthly salary. As a result, electricity consumption has already reduced significantly.
Lesson learnt: Staff motivation schemes with financial rewards are effective tools to ensure continuous energy efficiency improvements.

Electricity Incentive Scheme (based on 100,000 coil ton per month)

Electricity consumption per ton Liquid Steel (kWh/ton)	Incentive Scheme	Percentage electricity cost saving (as of 400 kWh/liquid ton)	Expected monthly cost savings (US$)
381 – 410 kWh	Incentive Scheme level 2	2.5 %	66,000
350 – 380 kWh	Incentive Scheme level 1	9 %	237,600

Yield Incentive Scheme

Process Yield (%)	Incentive Scheme	Percentage of improvement yield cost saving (as of yield 90.7%)	Expected monthly cost saving (US$)
90.0 – 91.9	Incentive Scheme level 3	0.27 %	135,000
92.0 – 94.0	Incentive Scheme level 2	2.53 %	1,265,000
94.0 – 96.0	Incentive Scheme level 1	4.75 %	2,375,000

To further reduce electricity consumption at the EAF, G-STEEL cooperates with the Iron and Steel making Institute of Thailand *(ISIT)* to find technical solutions for materials and energy conservation. This cooperation could further reduce the electricity consumption of EAF by 15 to 20 kWh per ton (liquid steel). In addition, G-STEEL's Energy Management System Committee has started a detailed electricity study for the entire plant with the aim to reduce the overall electricity consumption by 20 kWh/ ton HRC.

OPTIONS

- The focus areas selected were the furnaces, steam, compressed air and cooling towers. The company gave priority to the furnaces and Continuous Casting Machine (CCM) because of their high electricity and natural gas consumptions
- Numerous options were identified, and a total of six options were identified for further investigation, of which two were implemented during the project (see Table 1), and the remaining four options are to be implemented taking into account the company's production peaks and planned shutdowns (see Table 2)
- The two options implemented required and investment of US$ 210,000, with annual savings of US$ 15.3 million and a combined payback period of one week
- The two options implemented resulted in 70 GWh electricity savings per year and 42,947 ton CO_2 emission reductions per year

Table 1. EXAMPLES OF OPTIONS IMPLEMENTED

FOCUS AREA AND OPTION	TYPE OF OPTION	FINANCIAL FEASIBILITY	ENVIRONMENTAL BENEFITS	COMMENTS
Electric Arc Furnace/ Repositioning of EAF burner to increase consistency of injection and consumption of oxygen via oxygen	Improved Process Management	▪ Investment: US$ 10,000 ▪ Annual saving: US$ 3,839,168 ▪ Payback period: less than 1 day	▪ Electricity savings: 69.5 GWh/yr ▪ Emission reduction: 42,943 tons CO_2/yr	Oxygen is used as energy source in combination with electricity and natural gas

FOCUS AREA AND OPTION	TYPE OF OPTION	FINANCIAL FEASIBILITY	ENVIRONMENTAL BENEFITS	COMMENTS
lance *(see case study)*				
CCM process area/Overall yield improvement at the Continuous Casting Machine (CCM) process area *(see case study)*	Good Housekeeping New technology / equipment	▪ Investment: US$200,000 (Step 2) ▪ Annual saving: US$ 11,520,000 ▪ Payback period: less than 1 week	▪ Electricity savings: 5.76 MWh/yr ▪ Emission reduction: 3.6 tons CO_2 /yr	This option included improving operational practices and the installation of a Slag Detector System

Table 2. POTENTIAL OPTIONS FOR IMPLEMENTATION

FOCUS AREA AND OPTION	TYPE OF OPTION	FINANCIAL FEASIBILITY (Expected)	ENVIRONMENTAL BENEFITS (Expected)	COMMENTS
Electric Arc Furnace/ Improved foaming slag management	Good housekeeping New equipment / technology	▪ Investment: none ▪ Cost savings: US$ 730,000 /yr	▪ Electricity savings: 13.27 MWh/yr ▪ GHG emission reduction: 8.2 ton CO_2 /yr	▪ Implementation started in June 2005 and will take 8 months ▪ Funding provided by Thai Ministry of Energy
Cooling system/ Water conservation through leak repair and reduction of excessive water consumption	Good housekeeping	▪ To be determined (still under investigation)	▪ Water savings ▪ Electricity savings ▪ Chemicals savings	▪ Leaks: splash protection at laminar flow ▪ Reduce water use: cooling system of rollers
Compressed Air System / Installation of automatic operating controls and load balance system	New equipment / technology	▪ Investment: US$ 25,000 ▪ Cost savings: US$ 500,000 ▪ Payback period: less than three months	▪ Electricity savings: 9.1 MWh/yr ▪ GHG emission reduction: 5.6 tons CO_2/yr	▪ Electricity consumption target is 10 kWh/ ton HRC ▪ Improved leak management also to be implemented
Tunnel Furnace/ - Insulation of furnace refractory, entrance and exit - Cleaning and retuning gas burners	Good housekeeping	▪ Under feasibility study	▪ Natural gas savings	▪ Refer "Fish Bone Diagram" under Methodology section ▪ Implementation was started during plant shutdown in August 2005

FOR MORE INFORMATION

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