# CAMARGO CORRÊA METAIS S.A.

# BRAZIL'S MOST MODERN FERROALLOY FACILITY

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## INTRODUCTION

CAMARGO CORRÊA METAIS is part of the CAMARGO CORRÊA organization. CAMARGO CORRÊA is a diverse group of companies which owns and operates facilities in construction, banking, concrete, cement, farming and textiles within Brazil.

In 1976 CAMARGO CORRÊA CONSTRUCTION was the main contractor to build the first large scale hydroelectric plant located in Tucurui, Pará, Brazil. This was also the first large scale hydroelectric plant developed by ELETRONORTE, the state owned power authority in Northern Brazil. It was during the construction period of the dam (1976-1984) that personnel from the project discovered an abundance of quartz in the area. It was decided that due to the proximity of the Amazonia Forest, the hydroelectric power and the quartz the CAMARGO Group would build the first silicon metal plant in the region.

The advantages of this region were not only the raw materials but, also, the capital of the state of Para, Belém, is located only 300 Km North of Tucurui. Belém is a large international port which has easy access to the silicon metal markets in North America, Europe and the Far East.

The disadvantages of the area were the lack of qualified technical personnel in the region and the major distance from suppliers of equipment to operate the plant.

The plant, being remotely located in the Amazonia Forest region, necessitated a well planned, efficient facility. Thus, the CAMARGO CORRÊA METAIS S.A. company was started, adopting the philosophy to operate with well trained personnel and the most modern equipment.

The plant design and furnace equipment were supplied by MANNESMAN DEMAG. CCM required that the plant layout be designed to accomodate expansion. The 270,000 $m^2$ of property available for the construction enabled a spacious and efficient material flow with ample room for expansion.

The contract was signed on March 15, 1986, to begin work on this approximately $100 Million project. In two and one-half years (December 30, 1988), the construction of the plant was completed.

## PLANT DESCRIPTION

### Raw Materials

The Eletronorte Hydroelectric Plant, located approximately 4 kilometers from the CCM plant, supplies the silicon metal plant with 60 MW of power. The Eletronorte Plant is capable of generating 4,000 MW of power with a planned expansion of an additional 4,000 MW.

CCM owns and operates its own quartz mine located 20 kilometers from the plant site.

The mine has a modern washing and screening facility to insure properly sized quartz to the plant at the rate of 50 M.T. per hour. The quartz is delivered to the plant by truck. The truck unloads directly into a hopper which feeds an articulating conveyor to stack the quartz with minimal breakage.

The typical characteristics of the quartz are as follows:

| SIZING | % | CHEMISTRY | % |
|---|---|---|---|
| + 25 mm | 30 | $Al_2O_3$ | 0.01 |
| + 19 mm | 26 | $Fe_2O_3$ | 0.02 |
| + 13 mm | 22 | CaO | 0.009 |
| + 10 mm | 17 | $TiO_2$ | 0.03 |
| - 10 mm | 5 | | |

Presently CCM's charcoal is supplied by approximately 60 charcoal producers that are located within a 100 kilometer radius of the plant. These suppliers utilize more than 350 furnaces to produce the charcoal.

The charcoal is produced from various types of wood located in the area.

When the charcoal is received at the plant site, it is unloaded manually on to conveyors that stack the material in covered storage buildings. CCM has covered storage buildings to accommodate 12,000 M.T. inventory of charcoal.

Prior to the charcoal being placed in the raw material silos for use in the furnace, it is processed through a crushing and sizing system which sizes the charcoal to a 100 mm x 10 mm size. This system is controlled by a PLC (Programmable Logic Controller). It also has a dust collector system that collects the charcoal fines generated by crushing, handling and filling the silos.

Typical specifications of the charcoal presently being used:

| SIZING | % | CHEMISTRY | % |
|---|---|---|---|
| + 75 mm | 14.0 | C | 73-80 |
| + 50 mm | 35.0 | Vol. | 24-17 |
| + 25 mm | 30.0 | Ash | 2.5-3.5 |
| + 10 mm | 17.0 | | |
| - 10 mm | 4.0 | | |

CCM also owns and operates a 34,000 hectares farm 60 kilometers from the plant. This area is presently being planted with various species of Eucalyptus trees. CCM plans to produce its own charcoal for the operation of the four furnaces. The anticipated time to grow the trees and convert the wood to charcoal is approximately 6 years.

CCM has its own woodchipping facility at the plant site. It has the capability of generating 17 M.T. per hour of 100 mm x 25 mm woodchips.

For the start-up of such a large plant as CCM and due to the location, it was necessary to contract experienced personnel from the Southern regions of Brazil, but it is the plan of CCM to utilize the people that are available from the nearby cities and towns after training. At present 30% of the personnel at CCM are from areas outside of the region. By the middle of 1989 this number should decrease to approximately 15%.

Also prior to the start-up of the first furnace CCM gave extensive training to approximately 40 of their personnel from the areas of management, production, maintenance, laboratory and quality control in ferroalloy facilities in North America.

## Plant Power Distribution

As stated before, the CCM Plant at present has a maximum power demand of 60 MW. The power utility voltage is 230 KV reduced to 13.8 KV by two power regulating transformers.

These Brown Boveri transformers are rated at 50/75 MVA. The system is designed so that one 75 MVA transformer will control two furnaces with associated services. If one transformer malfunctions, it is also possible to operate all four furnaces with only one transformer. The system is also designed to accept an additional transformer. This would enable the plant to expand to more than four furnaces with minimal power interruption.

## Raw Material Handling System

Each furnace is equipped with five storage silos. These silos are filled by a system of conveyor belts that are controlled by a PLC. Although there are four separate sets of silos, it is possible to operate two furnaces from one set of silos.

The quartz silo is equipped with a spiral core which allows the bin to be filled with minimum breakage to the quartz.

Each silo is equipped with load cells to monitor the amounts of material at all times.

The weighing system is controlled by a computer that monitors all aspects of the weighing cycle at all times. Each furnace has a separate weighing system. Each system has three scales: 1 for woodchips, 1 for charcoal and 1 for quartz. After the material is weighed, the mix is layered onto a conveyor belt, which then deposits the blended mix into a storage silo. This layering of the mix and then storage in the holding silo results in a well blended and homogeneous mixture.

The system is also capable of weighing the charcoal by volume and adjusting the amount of charcoal in each mix depending on the moisture in the charcoal.

One weighing system is capable of furnishing mix for two furnaces if necessary.

## Furnace Design

The four DEMAG-designed furnaces have the following characteristics:

18 MVA Rating
3 -6 MVA Transformers

| | |
|---|---|
| Inside Diameter | 5500 mm |
| Hearth Depth | 2900 mm |
| Electrode Diameter | 1016 mm |
| Spacing | 2.2 d |
| Rotation | 3.5-3.7 m/day |

## Charging and Stoking Equipment

The furnace mix is charged and stoked with electrically operated Dango Dienenthal machines with interchangeable charging buckets and stoking booms.

## Control Room

Two furnaces are operated from one Control Room. Within the Control Rooms are located the weighing, furnace alarm, data logging and dust collector alarm systems.

The furnace communicates with the data-logging system through a PLC. The system is used to log all data relating to the furnace operations and monitors and records all alarms.

The data system is separated into four groups:

1. Monitoring of the furnace transformer and the hydraulic, water cooling and high voltage systems.

2. Furnace data; all electrical and temperature measurements.

3. Production information such as amount of alloy produced, analysis of each tap and consummable materials.

4. Detailed monitoring of the water cooling system.

There are two printers connected to each system; one for alarms and the other for furnace data. The system automatically prints a hard copy at the end of each shift.

A trend chart is available through the system that enables the operator to compare furnace operation over the past one hour, eight hours, twenty-four hours, thirty days or twelve months.

## Tapping Area

The furnace is tapped intermittently from a platform that is suspended from a rail that extends 360° around the furnace. The platform is driven by air motors. On this platform are attached an eight gauge kiln gun and electrode burner to assist in the opening of the furnace. The gun eliminates the use of an oxygen lance to open the furnace, thus reducing iron contamination.

The metal is tapped into ladles. There are back-up molds connected to the ladle cars to allow the furnace to be plugged without contaminating the metal.

Prior to tapping, the ladles are preheated to 1200° C to insure minimum loss of metal due to freezing in the ladle. Each furnace has its own ladle heating unit.

## Casting Area

Once the metal is purified, the ladle is transported by a 15 T crane to the Casting Area, designed to accommodate two furnaces.

The ladle is put into a ladle tilting machine, which pours the metal into rotating .4 $m^3$ circular molds. The molds are moved by a hydraulic system.

After the metal is cast, the ladle is cleaned of slag by means of a ladle skimmer, which is hydraulically operated. This equipment has a boom that extends the length of ladle with a two-sided cleaning tip which rotates 360°.

## Quality Control

CCM has established an attitude of producing the highest quality product possible. To achieve this goal, four major areas must be controlled. They are:

1. A total quality control concept utilizing statistical process control.

2. Flexible purification system.

3. Modern laboratory equipment.

4. An efficient crushing and sizing system.

The use of S.P.C. is one of the main operating tools at the CCM facility. The system has rigid control on all inbound raw material and operating procedures; such as tapping, purification, crushing and sizing of the material. The system has been designed to follow an individual furnace tap throughout the various handling processes in the plant until it is shipped to a customer.

The purification methods used are a stationary refining station or a porous plug system.

The refining station has the ability to bubble oxygen through a graphite tube and inject sand while bubbling. The stirring station allows additions to the ladles when necessary. The system is controlled by a PLC.

The laboratory is equipped with the most modern instruments available, such as the Phillips X-Ray fluoresence spectrometer and the CG scientific single beam atomic absorption spectrometer to assure the quality of the alloy being shipped from the CCM plant.

To analyze elements such as carbon and sulphur and amounts of volatile matter, ash and humidity, two different pieces of LECO equipment are used.

The X-Ray is linked to a computer and all laboratory results are stored in the system.

Of the 312 square meters of the laboratory's space dedicated for analyzing materials, the wet chemistry area consumes approximately 100 square meters. Not only raw materials and finished products are analyzed, but also the plant drinking and cooling water.

## Sizing

It was necessary not only to produce a high quality chemical product but also properly sized material.

To insure CCM's capability to meet the needs of the various sizes, a sophisticated crushing and sizing system was designed to achieve this goal, in conjunction with producing minimum undersized material.

The pre-crushing area is 5 m x 4 m with a grate opening of 203 mm x 203 mm. The metal can be put through this grate by means of a 5 T overhead crane or front-end loader. The material is broken through the grate manually.

The system has seven feed conveyors. The belts range in capacity from 5 to 85 tons per hour. The principal conveyor is equipped with a metal detector to avoid any contamination of the alloy. If a foreign object is detected, the system automatically shuts down. Five other conveyors have magnetic pulleys as a back-up system to insure no iron contamination.

Three crushers have been installed in the system to insure proper sizing with minimal fines generation. This design has two jaw crushers with a capacity of 15 to 40 $m^3$/hour. One jaw crusher can be adjusted from 100 mm to 25 mm opening. The other jaw crusher can be adjusted from 50 mm to 20 mm. The roll crusher is designed with a smooth finish with an opening from 38 mm to 3 mm. It has a capacity of 5 to 25 $m^3$/hour.

There are three screening units within the system. Two - 4 m x 1.5 m double-deck systems and one 3 m x 2 m single-deck system.

The system has five storage silos that can accommodate 10 tons of alloy each. At the bottom of each silo is a hopper scale of two-ton capacity. This system can fill approximately 20 super sacks per hour.

The system is controlled by a PLC and also has its own dust collector system.

The finished product storage area has the capacity to accommodate 8,700 tons of alloy.

## Interest in Ecology

Not only was CCM committed to build a modern ferroalloy facility with the highest quality product, but it wanted to achieve this goal with minimal disturbance to the environment.

One of the major sources of pollutant from a ferroalloy plant is fugitive dust. CCM uses the most modern pollution abatement equipment available, as stated in the previous description of the plant. The charcoal, purification and crushing and sizing systems have individual dust collector systems.

CCM is the first company in Brazil with state of the art dust collector systems for the furnace fumes. The plant utilizes two baghouse systems to evacuate the fume produced by the four furnaces.

The baghouse design is one of a fiberglass bag, reverse air cleaning and pneumatic transport system. It also has a pre-separator to avoid contamination of the silica fume with particles that are larger than 50 microns.

In the forest area CCM will use only one-half of its 34,000 hectares farm to produce charcoal. The other half remains as a wildlife preserve. Also, no natural forest area within 100 meters of the water is disturbed.

With concern about water pollution, any water that is recycled and deposited in the nearby lake is chemically treated and filtered.

## Conclusion

CAMARGO CORRÊA METAIS S.A. has taken a major step to be one of the first large industries to build a facility in the Northern Amazonia region of Brazil.

The company, with its use of computer-controlled processes, sophis-cated purification and sizing systems,has the desire to produce the highest quality silicon metal, not only for the needs of their customers today, but also for the future.