Design, manufacturing and supply of:

N. 1 ELECTRIC ARC FURNACE EBT
TYPE
50 TONS. TAPPING CAPACITY

presented by

Carlo Gennari Furnaces - Italy
Agency specialized in EAF-EBT furnaces supply for steel
EAF Electric Arc Furnaces, LF Ladle Furnaces, ladle treatment stations, vacuum degassing systems, electrode control, upgrading solutions, second hand plants
tel +39 02 2552271 fax +39 02 92878849 mob +39 335 8035324
e-mail: carlo.gennari@fastwebnet.it
web ste: http://carlogennariforni.beepworld.it/forniadarco.htm
skype : carlo.gennari11
1. BASIC DATA

- ELECTRIC ARC FURNACE EBT TYPE BASIC DATA

<table>
<thead>
<tr>
<th>Type:</th>
<th>AC-Furnace EBT pouring:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat size:</td>
<td>50 tons;</td>
</tr>
<tr>
<td>Shell diameter:</td>
<td>5.400 mm;</td>
</tr>
<tr>
<td>Slag door measurements:</td>
<td></td>
</tr>
<tr>
<td>* Width:</td>
<td>1.100 mm;</td>
</tr>
<tr>
<td>* Height:</td>
<td>900 mm;</td>
</tr>
<tr>
<td>Electrode diameter:</td>
<td>500 mm;</td>
</tr>
<tr>
<td>Electric pitch circle diameter:</td>
<td>1.100 mm;</td>
</tr>
<tr>
<td>Electrode stroke:</td>
<td>5.900 mm;</td>
</tr>
<tr>
<td>Electrode speed (automatic):</td>
<td>300 mm/sec max;</td>
</tr>
<tr>
<td>Electrode clamp release mechanism:</td>
<td>hydraulic;</td>
</tr>
<tr>
<td>Roof lifting height:</td>
<td>400 mm;</td>
</tr>
<tr>
<td>Tilting angle for tapping:</td>
<td>7-8° deg.;</td>
</tr>
<tr>
<td>Tilting angle for furnace emptying:</td>
<td>max 20° deg.;</td>
</tr>
<tr>
<td>Tilting angle for deslagging:</td>
<td>max 15° deg.;</td>
</tr>
<tr>
<td>Electrode and furnace movement:</td>
<td>electro-hydraulic;</td>
</tr>
<tr>
<td>Roof lifting speed:</td>
<td>110 mm/sec;</td>
</tr>
<tr>
<td>Roof swivelling speed:</td>
<td>5°/sec;</td>
</tr>
<tr>
<td>Cooling water operating pressure (nominal at furnace platform):</td>
<td>6 bar;</td>
</tr>
<tr>
<td>Cooling water inlet temperature:</td>
<td>35°C max;</td>
</tr>
<tr>
<td>Cooling water outlet temperature:</td>
<td>50°C max;</td>
</tr>
<tr>
<td>Transformer power:</td>
<td>40 MVA (not supply)</td>
</tr>
<tr>
<td>Secondary voltage stages:</td>
<td>700-500 V-10 taps ;</td>
</tr>
<tr>
<td>Maximum current:</td>
<td>63 kA max;</td>
</tr>
<tr>
<td>Electrode regulation system:</td>
<td>Electro-hydraulic;</td>
</tr>
<tr>
<td>Tapping hole diameter:</td>
<td>180 mm;</td>
</tr>
</tbody>
</table>

- ELECTRODES

| Working pressure of the hydraulic system: | 40÷60 bar; |
| Electrode adjustment (automatic): | max 100 mm/sec; |
| Electrode lifting (manual): | max 180 mm/sec; |

Hydraulic station
Layout pressure: 60 bar
Hydraulic fluid: Emulsion-water
Accumulator: about 6000 Lt
Pumps: 2 x55 kW (1 Stand by) 1 x 7.5 kW (recirculation unit)
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- FLUID AVERAGE CONSUMPTION FIGURES AND CHARACTERISTICS

OXYGEN
EAF consumption: max 40 Nm3/tons of steel;
Minimum pressure: 11 bar;
Purity: 97%;

INERT GAS
EAF consumption: 16 Nm3/h;
Pressure: 16 bar;

- COOLING WATER REQUIREMENT

Shell, roof and doors: 500 m3/hr;
Mech parts (EBT mechanism, hydraulic, electrode arms) 320 m3/hr;
Transformer: 80 m3/hr;
Flexible cables, delta closure: 10 m3/hr;
Burners and injectors (not supply) 290 m3/hr;
Input pressure: 6 bar;
Input temperature: 35°C max;
Temperature difference in/out: DT 15°C;

- OTHER CONSUMPTION FIGURES (FOR PLAIN CARBON STEEL PRODUCTION)

Electrical energy average consumption: 420 kwh/ton liquid steel;
Additive average consumption: carbon 20 kg/ton liquid steel;
Argon/Nitrogen consumption: lime 45 kg/ton liquid steel;
Argon/Nitrogen consumption: 0,06 ÷ 0,1 Nm3/ton liquid steel.

TAP TO TAP TIME (estimated) 50 min.
2. TECHNICAL SPECIFICATION

- **MECHANICAL AND HYDRAULIC EQUIPMENT**

- **FURNACE PLATFORM**

  Sturdy and robust electro welded steel construction which accommodates the Furnace shell as well as a large and strong bearing to support for:
  
The structure of the electrodes gantry column;
The frame supporting the furnace roof;
The furnace base frame basically consists of:
One (1) furnace platform equipped with tilting cradles;
Two (2) cradles rolling plates;
Two (2) tilting cylinders complete with supports;
Two (2) platform blocking devices.

- **FURNACE WATER COOLED PANELS**

  The “upper shell” part is equipped with water cooled panels consisting of a welded package of steel pipes. The panels are made of steel type St 35.8 I DIN 17175 in the upper part and of copper in the lower part (approx. 350 mm)
The water cooled panels of:
One set of Water cooled panels;
Set of water cooled panel above the EBT area;
Set of rigid and flexible pipes with corresponding shut off valves.

- **FURNACE SHELL**

  The furnace shell basically consists of:
Shell “bottom” part (30 mm thickness);
Slag door;
Eccentric tapping hole – EBT;
Flanges for the installation of the porous plugs for inert gas stirring;
Shell “upper” part (cage design in water cooled tubes);

- **FURNACE ROOF (WATER COOLED TYPE)**

  The furnace roof basically consists of:
One (1) sturdy steel supporting structure;
Three (3) water cooled panels;
One (1) roof center ring for refractory lining;
One (1) elbow for exhaust fumes;
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A series of rigid and flexible pipes which connects the input and water discharge manifolds as well as the various panels and elements which form the roof and corresponding shut off valves;
A series of sheets covering the outer part of the roof and protecting the panels and the connecting pipes.

• ROOF LIFTING AND ROTATING MECHANISM

The mechanism which lifts and rotates the roof basically consists of:
One (1) rotating gantry of sturdy steel construction;
One (1) rotating gantry column mounted on a large and robust roller bearing, powered by hydraulic cylinder;
One (1) frame fixed to the roof of sturdy steel construction;
One (1) device for roof lifting actuated by hydraulic cylinder;

• ELECTRODE SUPPORTING SYSTEM

The electrode supporting system basically consists of:
Three (3) sturdy steel columns for electrodes guiding;
Guiding wheels;
Three (3) lifting cylinders;
Three (3) electrode-arms with electrode spray cooling system (as indicate in the point 3.1.5.1);
Three (3) electrode-clamps;
Three (3) clamp opening/closing systems.

• “CURRENT CONDUCTING ELECTRODE ARMS FEATURES AND ADVANTAGES“
  (OPTION)

The electrode arms bodies are made in welded box type designed with a guide opening for the electrode holder and the flange for the contact pad on one and and the cooper terminals for the high current cables, the cooling water and the hydraulic connection at the other end.
Cooper plating on the steel arm surface in the area of the main current flow.
The arm is internally water cooled and feature inner stiffener ribs.
Three cooper contacts pads with channels for water cooling and four defined contact surface.
Contact pad is flanged to the electrode arm body.
Three electrode holders, consisting of a water cooled ring profile. the movable holders is held by guide in front of the electrode arm and fastened to the clamping system.
The holder close the counter pad to the electrode to the electrode contact pad.
Three electrode clamping devices, consisting of hydraulically operated cylinder for realising, Belleville spring washers for clamping and tie rod.
Advantage: during clamping only tension forces, during releasing only compressive strains.
No deformation of tie rod.
Clamping device safely integrated in the electrode arm and protected against induction current, no mechanical damages.
Three electrode sprays cooling rings fixed to the electrode holders.
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Cooling water pipes for installation of the electrode spray cooling integrated in the electrode arm bodies with connection.
Cooper terminals for two high current cables on each phase
Cooling water connection for the water cooling with flange connection.
Connection of the hydraulic cylinder of the clamping device.
The electrode arms are of “Current Conducting Electrode Arm” type, with the following advantages:
- lower electrical energy consumption,
- lower electrode consumption,
- cleaner system and lower costs for the maintenance.

- FURNACE SECONDARY CIRCUIT – HIGH CURRENT SYSTEM

The furnace secondary circuit has the purpose to connect the outlet terminals of the transformer to the furnace electrode arms.
The secondary circuits basically consists of:
Flexible cables;
One (1) current-carrying bus unit “DELTA” type.

REMARK
This equipment will be supplied by Thermomelt.

- FURNACE TRANSFORMER (NOT SUPPLY)

Technical specification for oil immersed transformer for electric arc furnace:
- Power: 40 MVA
- Quantity: N°1(one);
- Number of phases: N°03;
- Rated power/overload from 700V to 500V see basic data;
- Frequency: 50Hz;
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- Rated primary voltage see local net
- Rated secondary voltage: V 700-500,
- Secondary current: 63KA;
- Tap Changer N°10 pos.;

- MEDIUM VOLTAGE EQUIPMENT (NOT SUPPLY)

- One (1) Change over switch for insulating
- One (1) Circuit breaker for furnace
- Three (3) Voltage transformer (TV)
- Three (3) Current transformer (TA)
- One (1) set of filters for switch protection
- One (1) set of stop for transformer protection from the overload-current
- One (1) set of capacitive filters for the protection of transformer on the secondary from the overload-voltage

- FURNACE HYDRAULIC STATION

The hydraulic station basically consists of a complete power station accommodating the necessary equipment to service the various items which are:
Three (3) variable delivery pumps (2 "on duty" and 1 "stand by") to feed the furnace control hydraulic circuit;
One (1) accumulator;
Three (3) electrohydraulic valves for electrodes control;
One (1) recirculating pump for oil cooling and filtering;
One (1) clamp controlling pump;
Three (3) filters for the delivery pipes of the main pumps;
Two (2) filters for the recirculation pipes;
Three (3) servo valves for regulating electrodes;
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One (1) series of electro-distributors;
One (1) set of piping connecting the various users to the hydraulic station.
One (1) tank complete with all ancillaries equipment.
The hydraulic fluid will be non-flammable oil.

- ELECTRODE ADJUSTMENT ELECTROHYDRAULIC SYSTEM

The electrode-adjustment system is of the electrohydraulic type and basically consists of:

- Impedance control system which memories the input value of the various operating points;
- Furnace shut-off control;
- Supervision and operation devices;

The control system includes:
- Three (3) separate units, one per each electrode, to drive and control the electrodes individually;
- One (1) current limiting device common to the three electrodes.

- FURNACE PNEUMATIC CIRCUIT

The furnace is equipped with a compressed air circuit for cleaning purposes and electrode spray cooling system.

The pneumatic circuit basically consists of:
- A series of filters;
- A series of air lubricators;
- A series of rigid and flexible connecting pipes.
The circuit will be fed by the compressed air network of the plant.

- FURNACE WATER COOLING SYSTEM

The furnace water cooling system is of the closed type. It requires clean and soft (treated) water at a minimum working pressure of 4 bars.

The water cooling system basically consists of:
- One (1) set of flow regulating valves of the manual type for shell, roof panels and other furnace parts as well.
- One (1) set of shut-off valves for shell, roof panels and other furnace parts as well;
- One (1) set of flow indicators for shell, roof panels and other furnace parts as well;
- One (1) set of pressure gauges for shell, roof panels and other furnace parts as well;
- One (1) set of pipes and hoses on board the furnace to connect the various shell, roof cooling panels and other furnace cooled parts as well;

The furnace parts to be cooled with water are:
- Shell and roof panels;
- Slag door;
- Furnace roof;
- Elbow fume exhauster;
- Roof supporting arms;
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Electrode arms and related supports;
Electrode clamps;
Flexible cables;
Secondary bus system and related supporting frame;
Burners and lances (if any);
Hydraulic station;
Furnace transformer (not included in the supply);
The cooling system flexible cables system is equipped with the following components:
One (1) set of impurity collecting filters;
One (1) set of thermo-resistance for temperature control;
One (1) set of temperature recorders connected by cables to the furnace control cabin.

- Furnace Centralized Lubricating System

The furnace centralised lubricating system has the purpose to lubricate the furnace moving parts.

The system basically consists of:
Two (2) centralised distributors each fed by a manual pump to distribute the grease to the various lifting and rotating mechanisms of the roof as well as to the lifting mechanism of the electrode-bearing columns;
One (1) distributor fed by a manual pump to distribute the grease to the various items of the furnace tilting system;
One (1) set of manual greasing points for slag door and EBT slide gate system;
The grease lubricating system will be high pressure, heavy duty type.

- EBT Taphole Cleaning Platform

The cleaning platform will be made locally with the engineering and technical data of THERMOMELT.
The EBT cleaning platform basically consists of:
One (1) mobile, driven foot bridge of sturdy steel construction, Complete with hand rails, wheels, rails and necessary protections.
It is designed to facilitate the access to the EBT area for maintenance and control operations.
3. Automation Electric/Hydraulic EAF

The parts being evaluated in the scope of supply are:

- Panel **QMCC** (power and feeds)
- Panel **QPLC** (module with automation PLC and interface)
- Panel **QM** (module for protections and measures)
- Panel **QDRS** (Digital Regulation System)
- Main pulpit **PU1** (managing and moving controls EAF)
- Control pulpit **P CF/HMI-EAF** (Casting and Supervision Control System)
- Casting case

**Options**
- Second supervision PC
- Communication Driver for data acquiring from analysis and temperature instruments

3.1 SCOPE OF THE SUPPLY

**Components for EAF:**

*Carpentry and containers:*

- Nr.01 Modular Panel total sizes 2400b x 2300h x 600p composes of two modules 1200, IP55, painting RAL 7032. Carpentry to contain the **QMCC, QPLC, QM.** modules
- Nr.01 Reading Pulpit with inox plane 1200 for main pulpit **PU1**
- Nr.01 Reading Pulpit with inox plane 1200 for main pulpit PC, **CF-EAF** e **HMI-EAF**
- Nr.01 General breaker of suitable power
- Nr.01 Kit for line measuring (amperometer and voltmeter)
- Nr.01 Security Module for emergency and controls input
- Nr.01 Kit for aux. Power supply 110Vca 2KVA (transformer and automatic protections
- Nr.01 Kit for service Power supply 220Vca 2KVA (transformer and automatic protections
- Nr.01 Power supplies Kit I/O PLC 24Vdc 20A
- Nr.02 Unidirectional start-up devices 30kW composed of automatic thermal relay and contactor (High pressure pumps)
- Nr.01 Unidirectional start-up device 30kW composed of automatic thermal relay and contactor (Crown pump)
- Nr.02 Unidirectional start-up devices 5, 30kW composed of automatic thermal relay and contactor (Gearcase and compressor pump)
- Nr.02 Three-phase 16 A start-up for external power supplies (commutator and trafo pump)
- Nr.01 Kit for sectioner and breaker control
- Nr.01 Set of controls and signals for motors start-up and controls insertion
- Nr.01 Module illumination system

**PLC module for automation and interface QPLC:**

- Nr.01 Set of automatic switches for aux. Voltages distribution 220Vca – 110Vca – 24Vcc
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Nr.01  PLC S7-300 Siemens with configured CPU 315-2DP for 128 D/I, 64 D/O and 16 A/I suitable for connection in MPI for the PC and DP for the remote controls ET200.
Nr.01  Set of cards with 4 interface output relays (contactors, electrovalves, etc.)
Nr.01  Set of cards with 4 interface input relays (field limit switches)
Nr.01  Kit for sectioner and breaker interface
Nr.01  Temperatures control system for 16 PT100 directly connected to PLC
Nr.01  Kit for services power supply 220Vca 2KVA (transformer and automatic protections
Nr.01  Kit of power supplies I/O PLC 24Vdc 10A

Module for measuring and protections QM:
Primary Measuring and protection Kit composed of:
Nr.01  Measuring terminal board for connection 3V/2I ARON
Nr.01  Active and reactive energy converter with analog outputs
Nr.01  Net analyser connected in profibus for data towards the CF-EAF
Nr.01  Set of analog instruments for KW and KVAR
Nr.01  Primary max current relay I> >> 50-51
Nr.01  Minimum voltage relays
Secondary Measuring and protection Kit composed of:
Nr.01  Measuring terminal board for connection 3V/3I
Nr.03  TV secondaries  600/100
Nr.01  Net analyser connected in profibus for data towards the CF-EAF
Nr.01  Set of analog instruments for secondary voltages and currents
Nr.01  Secondary max current relay I> >> 50-51 (limit for rapid rise)
Nr.01  Module illumination system

Nr.01  Panel QDRS (Digital Regulation System)

 Casting case
Nr.01  Metallic case 400x500x200 IP55
Nr.01  Furnace Turnover manipulator (heating– scorify)
Nr.03  Key selectors (Securities By pass)
Nr.01  Pushbuttons enabling the turning over
Nr.02  Luminous pushbuttons for breaker managing
Nr.03  Signalling lamps
Nr.01  Emergency pushbutton

Main Pulpit for managing and movement of furnace PU1:
Nr.01  Set of automatic switches for aux voltages distribution 220Vca
Nr.01  Set of automatic switches for aux voltages distribution 220Vca
Nr.01  Kit of power supplies I/O PLC 24Vdc 5A
Nr.01  PLC S7-300 Siemens with configured ET200 for 64 D/I, 64 D/O, connected in DP with the CPU master into QPLC
Nr.03  Analog indicators of secondary voltage VE1 – VE2 – VE3 (phase/phase – phase/sole)
Nr.03  Analog indicators of secondary currents IE1 – IE2 – IE3
Nr.02  2-digits Display for converter position and current position
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Controls for furnace movement
Nr.03 Manipulators E1 – E2 – E3 – ASSEMBLY (rise – descent – automatic – bloc)
Nr.03 Key selector (jaws opening)
Nr.02 Pushbuttons enabling turnover and opening of jaws
Nr.01 Furnace Turnover manipulator (heating – scorify)
Nr.02 Crown manipulators (rises– lowers * in – out)
Nr.02 Luminous pushbuttons for automatic crown opening and closing
Nr.01 Kit for breaker managing (key insertion, consent, open, close, emergency)
Nr.12 Signalling lamps (electrodes positions, crown, clamps, etc.)
Nr.01 Alarms managing Kit (signalling, siren, reset)
Nr.04 Pushbuttons for exchanger rise/lower and current set-point
Nr.01 Kit for managing CF-EAF (aut-man, load, last container, end of casting)
Nr.01 Manipulator for door opening

Control Pulpit with one PC for CF-EAF and for HMI-EAF:
Nr.01 Set of automatic switches for power supply at 220Vca of the PCs coming from UPS (excluded form supply)
For casting controls of CF-EAF
Nr.01 PC rack 19” (Pentium III 1,26GHz, 20GB HDD, 256Mbyte SDRAM, Floppy and CD, Windows 2000 prof., 10/100 Mbit/s Ethernet
Nr.01 Dialog card between PC – PLC
Nr.01 License SCADA
Nr.01 License SW data managing
Nr.01 Membrane keyboard with IP65
Nr.01 Table Monitor TFT 17” fixed to the pulpit reading desk
For supervision HMI-EAF
The same hardware as for CF-EAF is used

Electrode digital control system (DRS):

- The features of the electrode control system are the following:
  - precise determination of the electrical data of the arc,
  - simulation of exact arc impedance,
  - exact measurement of the current,
  - fast response to deviations and signalization to the hydraulic electrode shifting,
  - simple pre-setting of reference values,
  - possibility for connection to process automation systems
  - avoidance of furnace shut-off due to short-circuits,
  - high operating safety and excellent dependability.

The task of the electrode control system of the arc furnace is to maintain as closely as possible the target operating setting, which is determined by the voltage step and the used power factor.

During the meltdown period, the full power of the transformer will be transmitted to the arc with highest efficiency.

However, because of the continuously changing distance between the scrap and the electrode, it is necessary to have a quick response system to keep the optimum working setting as accurate and fast as possible, by fast correction of the arc length.

The electrode control operates according to the principle of constant arc impedance, using the values for arc voltage and current supplied by the measuring system.
**Maintaining a pre-set working point means:**

The actual value of the arc impedance has to be continuously detected and compared with the pre-set value.

The electrode must be repositioned if these values differ, in order to bring back any deviation to zero.

Three servo-controlled valves, one for each electrode, are activated automatically according with the result of the comparison.

The system can work also in manual mode, by control manipulators and switches installed on the furnace control desk.

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**Furnace control system (LEVEL 1)**

The Programmable Logic Control (P.L.C.) system comprises the control and supervisory of the equipment for the furnace movements, the furnace transformer, the hydraulic system and the auxiliary drives.

The various control equipment is placed in a main control desk and panels housed in the furnace control room.

From the main control desk it is possible to control the furnace movements, including the manual control of the electrodes, the furnace breaker, the transformer tap-changer and the manual set-point inputs for the electrode regulation.

The control desk also contains a fault enunciator and measuring instruments for the primary voltage/current, the arc voltage/current, and the power factor \( \cos \phi \).

The energy consumption of the furnace is counted by a kilowatt-hour meter.

The active and reactive power (MW, MVAR) is duly recorded by a recorder.

The temperature of cooling water is measured with thermo resistance PT100 and all the information detected by the signals are displayed on a screen mounted in the control board.

The total water flow value for the roof and for the shell is properly displayed.

The low voltage system for the auxiliary drives is located in the furnace control room.

Near the tapping spout of the furnace there is an additional auxiliary control desk which is equipped to control the tilting motion of the furnace itself with the best operating view.

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**FURNACE SUPERVISION**

The system of furnace supervision, SCADA, is a HMI-EAF system for inspection and maintenance of the furnace unit.

Every event recorded by the PLC or by the operator is controlled by aid of graphic display of the state of the equipment.
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Figure 1. Data Flow
The check carried out by our system relates to

(a) Events from PLC:
- data in real time
- alarms

(b) Data from PC:
- data monitoring in real time
- alarms and events
- historic flow of alarms and events

(c) Events operator:
- alarms recognising
- insert set point

The synoptic tables allow an immediate check of the current situation of the system. Some structures as well as their characteristic parameters are represented.

This isn’t but a general view of the SCADA system, yet allowing to take advantage of a clear and complete monitoring potentiality as well as a real time check of the system.
Particularly useful are the pages of consents – breaker, arc, oscillation and E.B.T. – both for operator and in case of maintenance.
Recording of alarms and events can also help to solve troubles of the system and to find out the causes of problems had in the past, for example in case that responsible personnel weren’t present, helping this way to enhance the security of the equipment.
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**CF EAF**

The **melting control** of a furnace for production of steel (in billets or in pits) allows supervision and managing of all melting phases and the machining states:

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Melting Container 1</td>
</tr>
<tr>
<td>2</td>
<td>Melting Container 2</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>9</td>
<td>Melting Container 9</td>
</tr>
<tr>
<td>10</td>
<td>Refining phase</td>
</tr>
<tr>
<td>11</td>
<td>Operator phase</td>
</tr>
<tr>
<td>99</td>
<td>Casting phase</td>
</tr>
</tbody>
</table>

During the whole process, the available energy is supplied so that the operator can know at every instant how much energy has been consumed compared to the scheduled one and in this way to intervene in real time on the furnace control (Figure 1).

**Figure 2. Energy consumed and available represented by bar graph**
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Agency specialized in EAF-EBT furnaces supply for steel
EAF Electric Arc Furnaces, LF Ladle Furnaces, ladle treatment stations, vacuum degassing systems, electrode control, upgrading solutions, second hand plants
email: carlo.gennari@fastwebnet.it web site: http://carlogennari@forniarco.fm/forniadarco.htm

The concerned by the system are relating to (Figure 1):
Check of containers state
Automatic control of the Pre-refining and Refining Phase
Operator’s phase: Check of casting end

Calculation of energy and analogue consumption
Automatic running of the furnace
Managing times and delays
Filing (state of containers, consumption, duration of digital signals, chemical analysis of spectrometer, temperature of thermal probe)

The data relevant to voltages and absorption currents for the calculation of consumption are acquired and processed in real time. The PLC supplies the data relevant to analogue/alternate signals, iron alloys and digital.
The use of an integrated managing system for times and eventual delays (coded) allows a better supervision of the Melting as well as its optimisation.

The system also acquires the casting temperature during the melting phase, which is then filed. Moreover, a table is displayed indicating the theoretical temperature comparable with the measured temperature.

DRS (Digital regulation system)
Scopes and general characteristics of DRS system relating to the present document, are the following:
- Use of digital technology for Regulation of electrodes Movements
- Detailed acquirement of all situations concerning the electric furnace, in order to improve and optimize the global efficiency of the furnace
Remarkable improvement of the Regulation performances compared with electro-mechanic or analog electronic performances, the most marked improvements are:
- Stability of the arc
- Reduction of electrodes consumption
- Optimization of energy with reduction of used power
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Easy adaptation of the System to any type of hydraulic circuit being used (Oil-hydraulic or hydraulic unit, proportional valves or regulation poles, cylinders for oil or emulsified water movements)
The best results are anyway obtained by using the DRS with an oil-hydraulic circuit, a working pressure not greater than 100 bar, with proportional integrated electronic valves type Rexroth having short answering times; this type of oil-hydraulic circuit

The main characteristics of the System and of hardware and software components are the following:
- OPEN type system
- Easily expandable for future requirements
- Standard Hardware easily procurable
- Components of common use on worldwide market
- Function being totally implemented through software
- Configuration and programming on field
- No highly skilled personnel is required for use and Maintenance
- High technological content

The digital regulation, it could be in communication with the PC of supervision (HMI-EAF), and integrated with the PC of the inspector of fusion (CF-EAF).
The parameters of the regulation, setting from supervision, act independently from the phases of fusion of the oven. The formulations, visible in the page following graphics, they instead show like any parameters, most important, they have the possibility of have diversified in base to the percentage of fusion of the basket. In this way, the maximum flexibility in her is had begun to point of the regulation.