



Foundry

Measurement in Ferrous and Non-Ferrous Melts

Measurements in ferrous and non-ferrous melts

Temperature



Introduction

The knowledge of liquid metal temperature is essential for the production and quality control of steel, cast iron and non-ferrous alloys. The molten metal temperature must be within strict limits to achieve the optimum quality before the heat or melt can be tapped or cast.

The disposable thermocouple is pushed upon the probe holder of a suitable immersion lance until electrical contact is achieved with a built-in contact block. An inner and outer extension cable related to the thermocouple type connects the immersion lance to the measuring instrument.

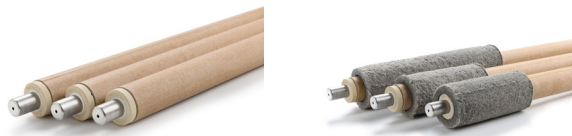
Thermocouples

Immersion thermo-electric sensors remain the best way to determine the real temperature of a molten metal. They are available in various types to meet the specific requirements of different application.

SINGLE DIP

POSITHERM®

Standard thermocouple with metal cap inserted on a cardboard tube that protects the immersion lance from melting.



POSITHERM® NON SPLASH

An extra mineral sleeve around the dipping head preventing the splash of the cardboard tube.

MULTIPLE DIP

POSITHERM® LONG QUARTZ

In shallow, slag free melts a positherm® with an extra long quartz U-bend can be used.



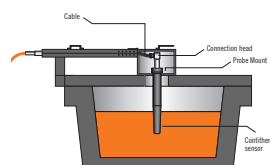
MULTI-STIK

For deeper multiple dips into slag-free melts, there are 3 types in increasing order of robustness available: multi-stik, maxi-stik and XT (Extra-Therm)

CONTINUOUS DIP

CONTITHERM®

The unit is hanging in the melt through a single cast sequence or through a multiple of shorter sequences.



CASTEMP®

The probe is inserted through the sidewall of the tundish or ladle, measuring temperature throughout the casting sequence.





Measurement systems

There are two distinct systems based on handheld or wall mounted instruments. Both systems have the optional capability to wireless transmit measurement results and log them with the MeltControl Data Management System. The advantage of handheld systems is that they stand alone. Continuous temperature measurements come only with wall devices and special hardware.

HANDHELD SYSTEM

DIGILANCE V



Digilance V with immersion lance mounted directly onto the handheld instrument, a light construction

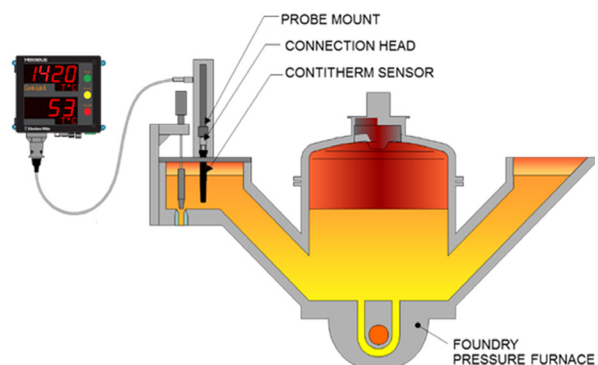
WALL-MOUNTED SYSTEMS

DIGITEMP® E



DigiTemp®-E with hand lance connected to the instrument by means of an external compensation cable or wireless without cable (QUBE®), a heavier construction

CONTILAB E



Contilab E for continuous measurements with a hot-zone cable connected to the temperature sensor.

Measurements in ferrous and non-ferrous melts

Chemical composition



Introduction

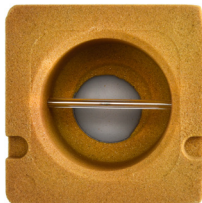
Cast iron is by definition a Fe-C alloy containing also Si, P, S, Mn and all other elements in variable amounts. To control the casting process it is important to know the carbon equivalent, saturation degree, C and Si content in cast iron. There are two ways doing this: by taking a sample or by thermal analysis.

Thermal analysis

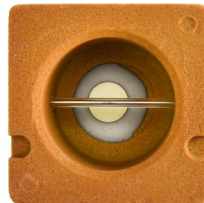
This technique utilizes cooling curves from special crucibles (QuiK-Cup® disposable measurement test cups) to calculate the chemical composition (carbon equivalent, carbon and silicon). If white solidification is required, a special tellurium mixture is cemented on the cup's bottom.

WHITE SOLIDIFYING CUPS

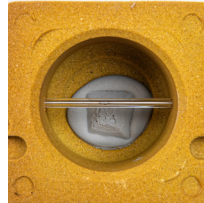
QC Te



QC TeS

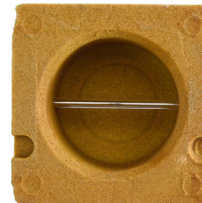


QC TeTe



GREY SOLIDIFYING CUPS

QC



QC Cov2T



Measurement system

The QuiK-Cup® is placed on a cup holder with contact block for the cup, either connected to the QuiK-Lab® E instrument with an extension cable or on a mobile wireless holder. The QuiK-Lab® E system measures the cooling attributes of the molten iron poured into the QuiK-Cup®. The instrument displays the measurement values in real time. The system, combined with the MeltControl software, shows the cooling curves.





Samplers

Cast iron can solidify white or grey. White samples are quickly chilled and obtained by built-in cooling plates. Grey samples are exposed to a slow, normal cooling rate. The white chilled samples are further analysed by spectro analysis. The grey samples are for acoustic (block) and porosity analysis (cross).

WHITE SAMPLERS

SAF



SAF-Disc Only



GREY SAMPLERS

SAA



SAA Cross



Sampling equipment

For shallow dips lances are used to take a sample. In case of a deep immersion, the best protection against splashes is given by cardboard tube that is covered with a harmless refractory material or dried cardboard tubes.



Measurements in ferrous and non-ferrous melts

Oxygen activity



Introduction

The free oxygen activity in the melt is directly correlated to the nodularity and final mechanical properties of the cast iron. Using the Celox®-foundry measuring system, the foundry man has a suitable instrument to control the addition of Mg and the graphite shape (%nodularity) in ductile iron (GJS) and compacted graphite iron (GJV). The complete system for measuring oxygen activity consists of the Celox®-foundry instrument, the Celox®-foundry power box, and the attached Celox®-foundry vibration lance and Celox®-foundry nodularity sensor.

Celox®-foundry nodularity sensor (CF-Nod)

The Celox®-foundry nodularity sensor consists of a thermocouple for the measurement of the bath temperature (T in K)

and an electro-chemical cell for the measurement of the EMF (E in mV). The initial oxygen activity is calculated using Nernst's law.

Celox®-foundry instrument

The Celox®-foundry instrument is ideal for use on the shop floor. It is simple in use with fully automatic operation during measurement. User-specific parameter settings and data telegram selection can be made using the LCD operator interface. The system can also easily be implemented in the MeltControl data management system.



Measurements in ferrous and non-ferrous melts

Advanced thermal analysis

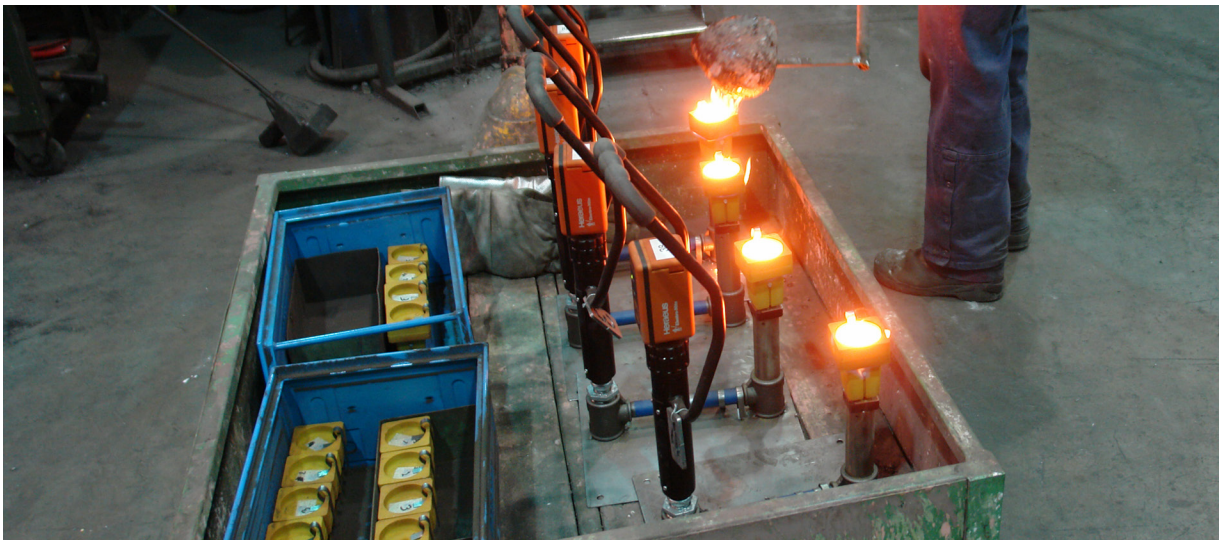


Introduction

Measurement of the eutectic minimal temperature T_{Emin} or the Undercooling ($= 1150^{\circ}\text{C} - T_{Emin}$) with special small volumes and closed cups enable to control inoculation and predict certain mechanical properties of the cast iron.

By inoculation is meant the addition to the molten iron just before casting of products mainly based on Ferro-Silicon-alloys with active elements like Sr, Al, Ba, Sb, Bi ... in order to increase the nucleation potential of the melt for graphite.

Inoculants strengthen the tendency to grey solidification and increase the number of eutectic cells (grey iron GJL) and of nodules (ductile iron GJS).



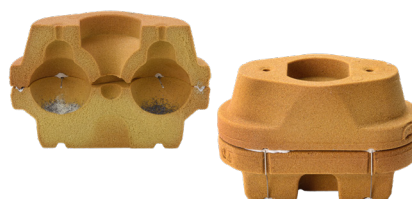
QUIK-LAB® E-SYSTEM

With the QuiK-Lab® E system in combination with the QuiK-Cup® Cov2T the temperature can be measured in small volumes. Due to the 2Tapes at the cover inlet, the cups can be filled by a very few amount of inoculant. The system can be linked with the MeltControl data management system.



MELTCONTROL AND THERM-O-STACK

The Therm-O-Stack is a cup with 2 chambers that are simultaneously filled. It is a stable form until the eutectoid transformation. Eutectic freezing happens in approximately 90 seconds. Data is visualized, logged and can be used to calculate microstructural and mechanical parameters by the MeltControl Software.

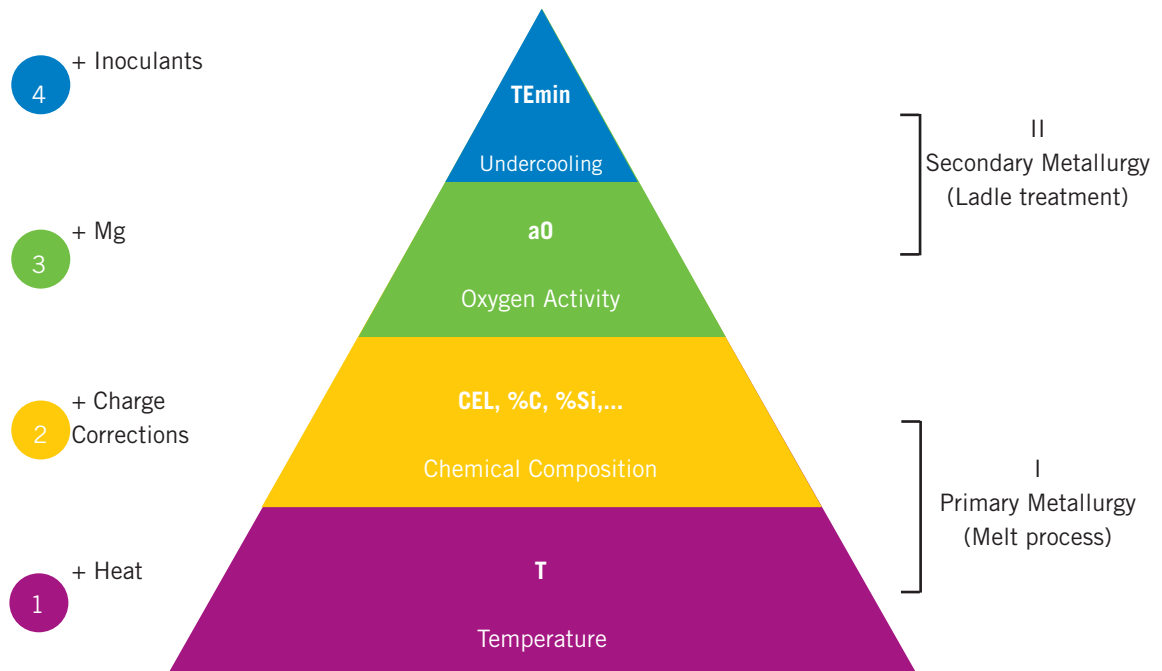


Measurements in ferrous and non-ferrous melts

Sequence of measurements

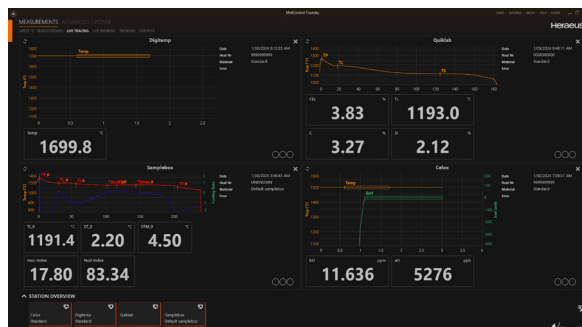
Pyramid

There is a hierarchy in the measurements for metallurgical process control. The upper layers are dependent on the underlying layers.



MeltControl

MeltControl is a data management system that gives foundry engineers and managers access to all foundry data. It logs and displays real-time measurement curves online. A smooth connection of a wide range of instruments (QuiK-Lab® E, DigiTemp® E, Digilance, Celox® Foundry, ...) is possible and measurements can be viewed at the same time at different client computers.



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