INCREASING THE CONSISTENCY OF IRON CASTING PROPERTIES AND REDUCING FOUNDRY REJECTS BY THE USE OF FERROLAB* V THERMAL ANALYSIS EQUIPMENT

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Producing high quality iron castings requires high quality, consistent liquid iron.

The quality of the liquid iron depends not only on its chemistry, but also its inoculation state – the ease of forming the physical iron structure on cooling.

Thermal analysis provides a fast and cost-effective way to assess the inoculation state of liquid iron, ensuring that it can be made consistently from one batch to the next.

This article describes the simple and robust device – Foseco's FERROLAB V Thermal Analysis Equipment. It further shows how it can be used by Romi foundry in Brazil to check, adjust and record the thermal fingerprint of each batch of iron.

INTRODUCTION

To make a high quality casting it is obvious that the liquid metal used to make it must be of high quality.

Firstly, the chemistry of the iron must be correct. This usually means monitoring Carbon using a CE meter or combustion analyser, and other elements using a spectrometer and keeping them within accepted ranges.

However, having the correct chemistry of the iron is only part of the story, we also need to know that the inoculation of the iron is correct.

The number of sites available for the deposition of the first solids forming as the iron cools has a tremendous effect on the structure of the solidified iron. Though the chemical composition of the iron hardly changes, the addition of a good quality inoculant such as Foseco's INOCULIN* to a poorly inoculated iron can totally change its properties.

Inoculation affects the amounts of carbides, how much shrinkage occurs and the strength and ductility of the castings it produces.

The best way to know how a casting will solidify is to take a sample of the liquid iron and record its solidification. We can do this using FERROLAB V (five) equipment supplied by FOSECO.

The sample is poured into the INOCUP test cups and in around 300 seconds we have a clear presentation of the parameters most important for controlling the iron.

The parameters can be used initially to categorise the iron and assist in determining the correct type and amount of inoculant. The foundry can then set its own specification for ranges of the parameters acceptable when in general production.

The unit can then be employed as a quality control tool, to make sure the iron is within specification and to highlight cases when adjustment may be required.

FERROLAB V

Calculations are performed in an industrial pc that is robust enough to be used in the foundry environment, but can be located in a control cabin. The computer connects wirelessly to the FERROBOX data acquisition unit located near to the sampling station.

A simple set of traffic lights on the FERROBOX lets the operator know that the sampling cup is correctly placed and ready to use.

THE KEY TO FERROLAB V IS ITS SIMPLICITY

The FERROBOX can be placed on the melt deck and can sample two cups. Two FERROBOXES can be connected wirelessly to each computer. This allows a range of possibilities for sample taking.

For example, stable analysis of solidification parameters for up to four furnaces, or alternatively configurations for metastable analysis using tellurium containing cups or for checking inoculation after ladle treatments or immediately before pouring.

The results of the test appear colour coded. As would be expected, green is good, yellow is borderline acceptable (requires checking) and red is out of specification. General parameters are preset, but obviously these can be adjusted to the foundry's preferences.

The colour coding means that for QC purposes, operators do not need to be trained in thermal analysis, but rather can call a supervisor if the results are borderline or out of specification.

As well as critical parameters, the system displays the cooling curve and the first differential, so experienced TA users can immediately identify the characteristics of the iron.

All of the data from tests is stored and recorded, so can be used as part of the quality control record.

Previous results can be retrieved and displayed. The system allows the comparison of multiple cooling curves and derivative curves for investigative purposes.

Of course it's not just the iron in the furnace, FERROLAB allows you to look at ductile iron after the nodularising treatment, and inoculated iron right up to the moment it is poured.

The equipment is robust, and because two acquisition boxes can be connected wirelessly to one computer, you can analyse up to four cups in two different locations

The system is provided free of charge to Foseco customers that buy our inoculants, nodularisers and sampling cups. And we work together with them to ensure that they can consistently produce the highest quality iron possible.

Figure 1. FERROBOX data acquisition unit

PRACTICAL APPLICATION OF FERROLAB V AT ROMI FOUNDRY BRAZIL.

FERROLAB V equipment was installed at Romi, a medium sized foundry in Brazil producing Ductile Iron castings. The equipment was installed with one channel acting as a standard CE meter, and another performing stable analysis to give information of the casting structure.

Use of the equipment is still in the early phases, but already the foundry has started to modify the treatment process to make best use of combinations of inoculants and nodularisers on offer. From figure 3 we can see that the standard material treated with 1.3% FSM (5% Mg) and standard inoculation is of relatively good quality, but it may still be possible to improve on this.

Figure 4 shows how the iron has been improved, firstly because its composition has been moved closer to eutectic, meaning a shorter freezing range. Secondly a preconditioning treatment and late stream inoculation have been added. These reduce the amount of undercooling before solidification and recalescence during solidification having the overall effect of moderating the solidification process and giving a better structure.

SG iron preconditioned with INOCULIN* 390 in furnace. 1.5% NODULANT* FSM, 0.3% INOCULIN 320 inoculation + 0.2% post inoculation with INOCULIN 920 (simulated with addition in cup). Comments: Nearer eutectic but higher TeMin and PAE and lower VPS than without post inoculation.

Further trials will allow Romi to further optimise their inoculation and nodularisation practices.

From this point Romi will be looking for castings that lie at the limits of their specifications and using FERROLAB V will create systems allowing them to move the quality even closer to their target.

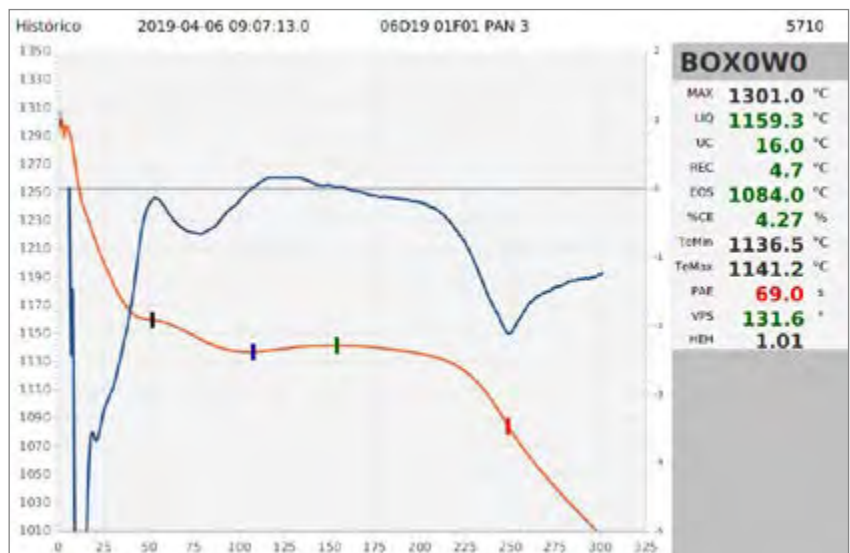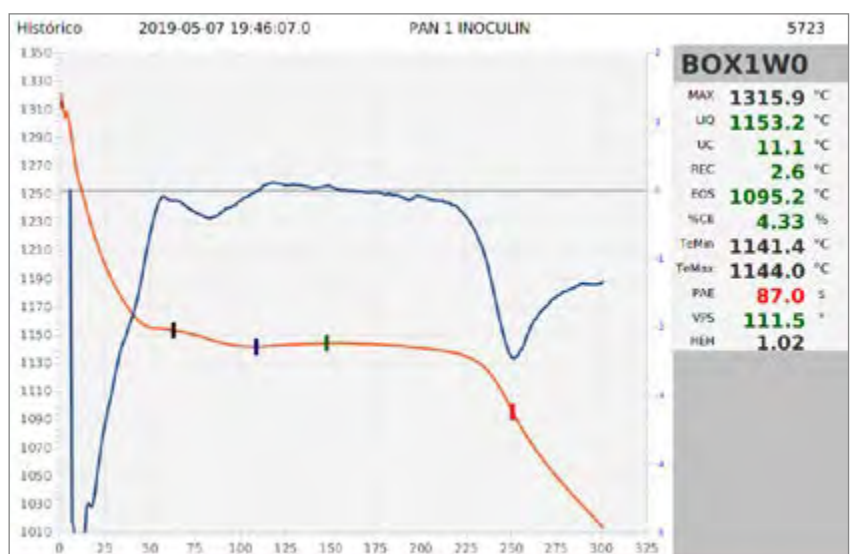Figure 2. Romi Foundry, Brazil

Figure 3.

Figure 4.

SUMMARY

FERROLAB V is a simple and highly cost effective route to increasing quality and reducing the number of defective castings by the use of Thermal Analysis.

ACKNOWLEDGEMENT

ABOUT THE AUTHOR

Colin Powell is the International Marketing Manager for Foundry Melt Shop at Foseco International Limited. He is responsible for marketing and management of all products used in the melting area and has worked for Foseco for 34 years. His favourite aspect of the job is helping customers get the most from their processes. In his free time he enjoys renovating his home.

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