Rethinking Iron Thermal Analysis

Synopsis:

For the longest time, we have been using the definitions of others. It is time to correct some of these erroneous definitions and get back to sound metallurgy. Much of the initial thermal analysis research was done by great people but with primitive instruments. Better instrumentation has led to a greater understanding of metal solidification and so proper definitions need to follow this new understanding. With Version 6 of MeltLab we are making several changes to the way we think about metal solidification.

Start of Nucleation

This is a generic term that applies to any metal. It replaces the term for the end of the steady state cooling rate of the liquid. It is the beginning of crystallization of the metal and is used as the starting point of the baseline or zero curve. The baseline curve is used to calculate the percent solidification and to integrate the various components of the metal (Dendrites, Eutectic, Carbides, Shrinkage, etc.). Before we sometimes used *Start of Liquidus* for this point, but often with higher carbon content irons, there is no liquidus.

Grain Boundary Maximum Stress point

This is the maximum cooling rate at the end of solidification, but is it really the end of solidification? It is an endothermic (heat adsorbing) arrest caused by the grain boundaries freezing off. The casting is not completely solid until this arrest finishes. So we are removing the name “Solidus” and “End of Freezing” from this point and moving it to where this reaction is over with.

Solidus/End of Freezing point

The term *End of freezing* was first proposed by Dr. Carl Loper and we adopted it in 1992. Later, after being educated by Professor Richard Heine in 2000, we also called it the *Solidus* point. But we were using the highest stress point, not when the grain boundary freezing was finished. So with version 6, we have moved the Solidus arrest to a little lower point, where the grain boundary stress arrest finishes and the casting is truly solid.

MeltLab Version 6 for Iron Microstructure

This version of MeltLab has a tentative release date of January 2016. It will include the new features of percent solidified, percent austenite, percent eutectic, and speed of eutectic nucleation, eutectic growth energy, estimated nodule count, and nodularity for ductile iron or graphite shape for gray iron, as well as shrink percentage and kind of shrink. It picks up and measures both pre-eutectic and post-eutectic carbides. This is the most recent technology in Thermal analysis and only offered by MeltLab Systems – the Leader in TA.

MeltLab Version 6 for Iron Chemistry as opposed to Iron Microstructure

Similar to the Microstructure version, this will include percent solidification, percent austenite and percent eutectic. But it is without graphite measurement and the items affected by graphite growth. This version is meant for measuring base iron for C.E. Carbon and Silicon but does include the ability to measure both hypo and hyper eutectic irons up to about 4.9 C.E. This is the more traditional thermal analysis method that has been used since the 1970s.

