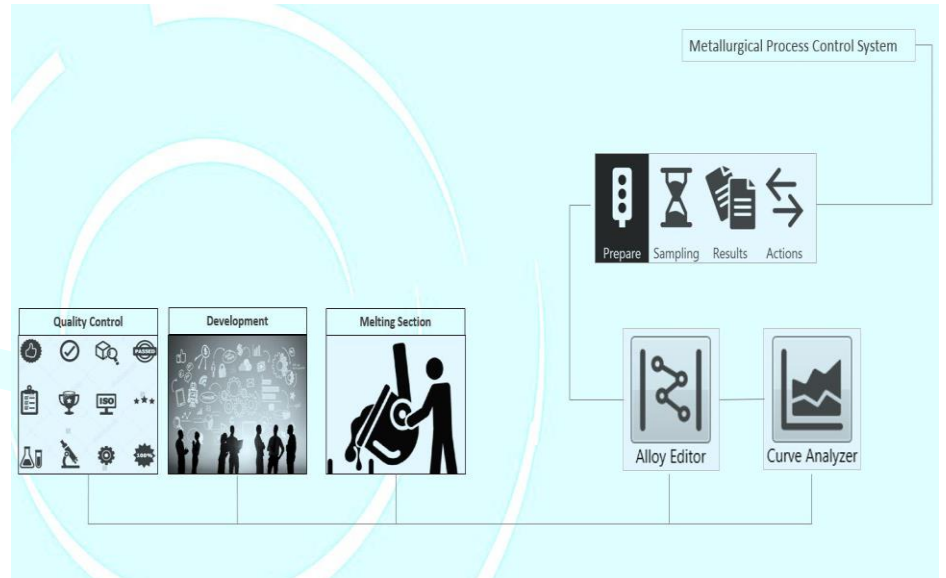
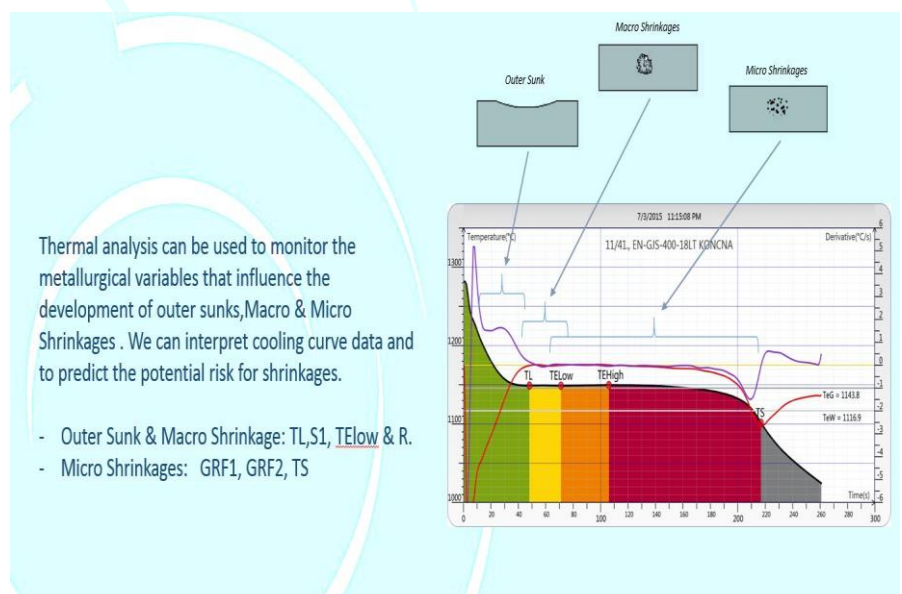


Control & Optimization of Gray and Ductile Iron Production Using Thermal Analysis

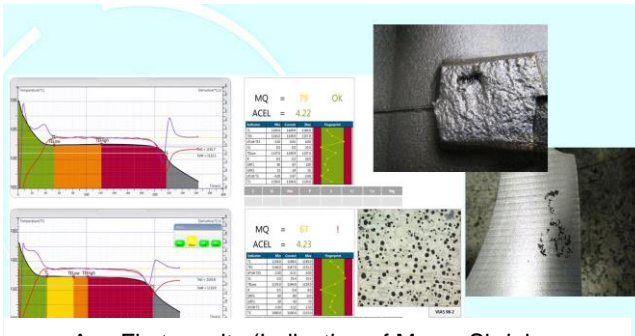
- 1- In Kovis Livarna we use thermal analysis in the process to monitor, control & optimize aiming to secure our quality and promote more advanced alloys.



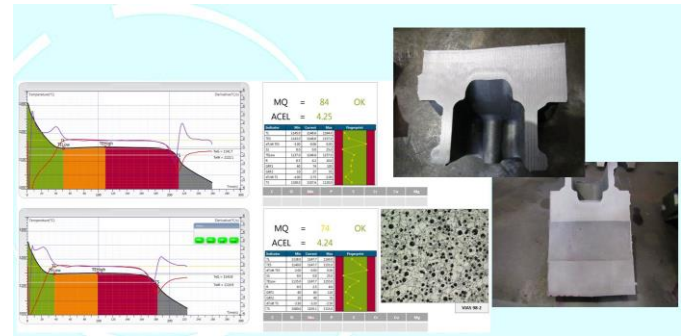
- 2- The importance of using thermal analysis and the understanding of our main parameters TL(Liquidus temperature), Telow(Lowest eutectic temperature), TS(Solidus temperature), R(Recalescence, $T_{Ehigh} - T_{elow}$), S1(Percent surface area between TL-Telow), GRF1(graphite precipitation in semi liquid), GRF2 (inverted heat conductivity in solid) that we use to predict the likelihood or possibility of having defects. Classifying the defects to different types depending on the size and mechanism of each one (micro, macro shrinkage, outer surface sunks) allows us to find a quick remedy and avoid major problems.



- 3- Combine the parameters regarding one specific casting and study the case, then decide which is the most suitable actions are necessary to be taken first to reduce the tendency of having defect, as you see in picture A&B.



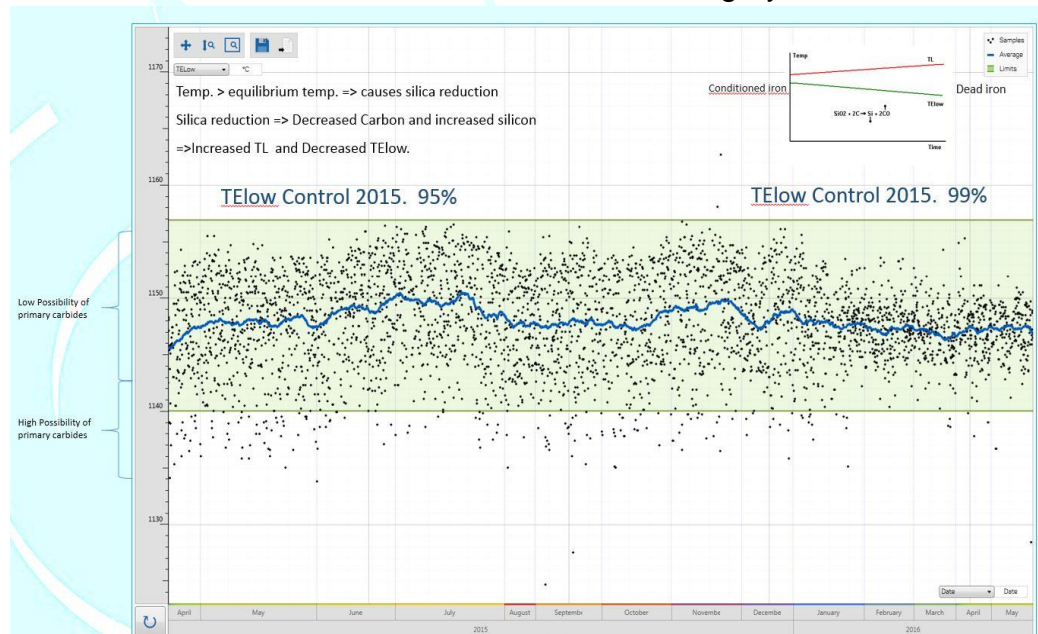
A- First results (Indication of Macro Shrinkage)



B- Second results (No defect indication)

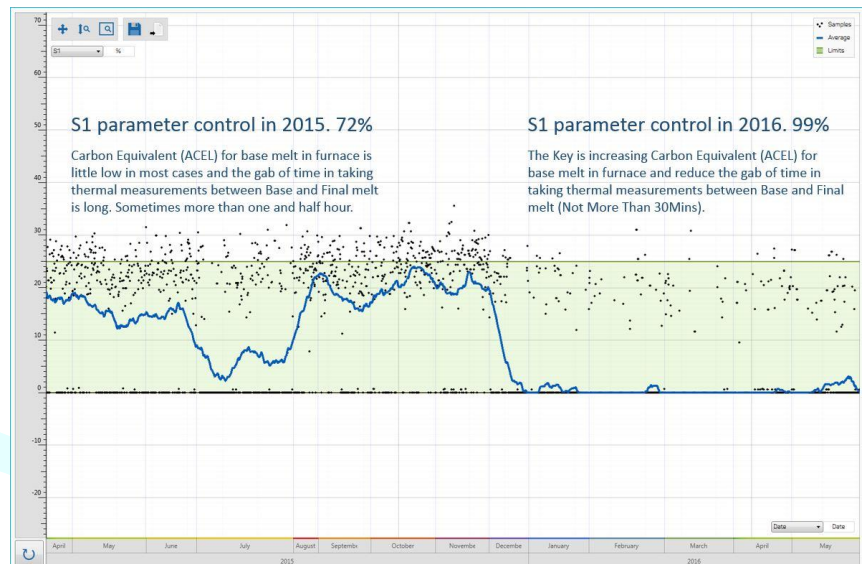
- 4- Since having the new thermal analysis software. To optimize each alloy, we had to go through the phase of collecting the data from our normal process parallel with the lab results and decide if we need to adjust some parameters to fit more in our process. We will talk about three main parameters. The first is TElow: It is the lowest Eutectic Temperature calculated from the second arrest in temperature with time from the first derivative following it an expansion in the melt. In our foundry only too low values below 1140C is critical for ductile and grey iron.

Over 1000 sample in 2015 showing some of them have too low Eutectic Temperature, and high risk of defect. Then by controlling the main factors on this parameter we managed increase the control by 4% in 5months.



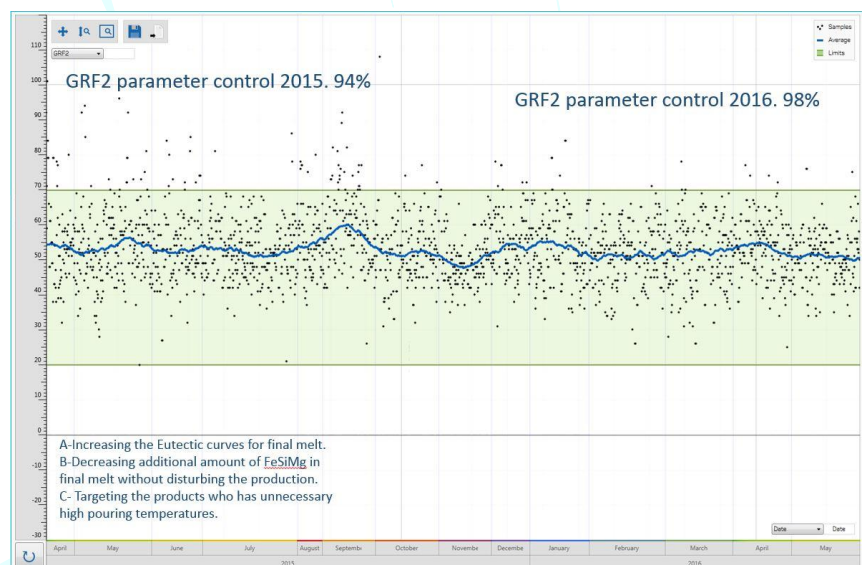
- 5- S1: It is the amount of primary Eutectic (Primary Austenite in hypo and primary graphite in hyper). High Value in our foundry for ductile iron increases the tendency of having macro shrinkage defects, so it is favourable to have it in very low level. The effect of this parameter reflects directly on the smoothness of filling the cavity of the mould and the efficiency of the feeders.

From collecting all data and compare the results with our lab. We managed to target and control all The factors that influence directly on this parameter. In 2016 we managed to reduce the negative effect of high values on 400-18 alloy, and increase the control by 27% in 5months.



- 6- GRF2: It is representing the heat conductivity of the melt in the end of freezing from the sampling cup. From cooling curve, it is the angle of the last negative peak of the first derivative, and it is important to have it always low value with minimum variation. Reduce the risk of micro shrinkage.

As we mentioned previously. Through collecting and comparing the results, and adjust the real factors, we managed to optimize it and have 94% within control limits in 2016.



Possibilities to have/We have by Using Thermal Analysis in IronCast Production

1. Verify the melt in a reliable way before pouring (Quality Assurance).
2. Improve yield – reduction of riser sizes or elimination of risers.
3. Reduce scrap due to metallurgical problems.
4. Minimize risk for unexpected problems. Process verification.
5. Achieve more consistent physical properties.
6. Reduce costs for charge/Treatment Materials.

