BTA/RE/11-08  Hot metal quality in the hearth of an iron making blast furnace
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Abstract

After fifteen years of service, blast furnace #7 at IJmuiden’s Tata Steel operation was blown down on the 31st of August in 2006 for a small repair. The blow down and salamander tap were successfully completed and afterwards the furnace was quenched with water. All remaining liquids are solidified followed by excavation of the remaining skull. Copper was added to the last ore dump to distinguish the liquids prior to the quench.

Around 300 holes were drilled in the skull, used for explosives. The cores were gathered and used for analysis. Several cores have been analyzed with X-ray fluorescence spectrometry; these rough data were the base of this study.

Carbon lamellas were observed in certain areas of the skull. Their formation appears during slowly cooling of flowing hot metal. These lamellas confirm that part of the skull was solid previous to the blow down of blast furnace #7.

Radial variation of silicon is not detected. Results do show a distinct boundary, which separates material with different concentrations of copper. This is possibly a result of early solidification of the skull.
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6. Conclusion

The data has been successfully converted from counter points to concentrations. Where after the data is filtered on hot metal, the resulting data is plotted and interpolated to give a 3D visual of each element in the hearth.

- **Copper** content resulted in the discovery of a boundary at the 1800mm level. This boundary gives an indication of what was liquid and solid prior to the blow down.
- **Manganese** shows limited prove for radial variation. Concentrations are constant along the z-plane and the radius varying between 0.23 and 0.27 percent below the boundary.
- **Titanium** proves its use as a lining protector. Near the walls, bottom and tap holes it’s concentration increases up to 1.5%.
- **Carbon** does show radial variation with increased concentrations in the center. This indicates incomplete reduction in the center, where the tuyeres have less influence.
- **Silicon** content was expected to show radial variation. The results do give indications but they lack in strength.
- The same accounts for **Sulfur**, there is a lack of evidence for radial variation.

Carbon lamellas were found in several areas of the blast furnace. The liquid hot metal slowly cooled whilst flowing through the hearth. Where flow continued lamella could grow until temperature dropped and hot metal solidified in the pores. The formation of carbon lamella points at a uniform oversaturation of carbon in the hearth.

Evidence for radial variation is limited. Carbon from coke particles disturbs the evidence for radial variation of carbon. In the part of the skull that was supposedly liquid prior to blow down, evidence is found for radial variation, although this liquid must be disturbed by the salamander tap and the blow down situation itself.

No evidence is recorded for the time and manner solidification occurred.
The full version of the report can be requested at TATA Steel Ijmuiden’s Research Development and Technology Department under reference source number: 153291