

Master Project

Transferring Domain Knowledge to Data-driven Controller

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Context

Tata Steel in IJmuiden has devised and developed a technology to make steel in the future with 20% less CO₂ emissions: HIsarna. Scientists and steel manufacturers from all over the world are closely following the development of HIsarna. HIsarna has every possibility of growing into a real game changer in the steel industry. HIsarna is an alternative to the blast furnace process. To be able to make liquid pig iron in a blast furnace, it is necessary to pre-process ores and metallurgical coal (the raw materials) into sinter (light chunks of iron ore), pellets (marbles of iron ore) and coke. The HIsarna process makes these steps superfluous: in the HIsarna installation, the raw materials can be used in powder form and be directly converted into liquid pig iron.



HIsarna consists of a reactor which maintains a temperature above the melting point of iron throughout, so that the injected iron ore immediately melts and is converted into liquid hot metal. The very high temperature of the process gases in the melting vessel is further increased in the cyclone at the top of the reactor by the addition of pure oxygen, which reacts with the carbon monoxide present.

Currently the technology is at Pilot Plant level. A relatively small scale pilot plant is operational to proof the viability of the process and pave the way for an industrial size plant. The goals for the



pilot plant is to understand the process through data and, more importantly, to find (automated) control rules of the process. Many rules have been found by experts in the field but the rules have not formalized into an automated controller. The real challenge is to distinguish between the effect of an intended control action and other factors of influence. Formalizing control logic is essential for improving the process further.

Project tasks

This master thesis project aims at identifying the most suitable control rule(s) as well as at designing and validating an automated controller.

1. Identify the most suitable rule to be automated together with HIsarna Technologists. Rules that can be thought of are oxygen distribution in the vessel or hot metal temperature control rules.
2. Collect the data required to design and validate the control logic.
3. Design and validate the control logic.

This master thesis project is done in cooperation with Tata Steel Europe, HIsarna Pilot Plant department. The resulting control algorithm will be designed and validated experimentally.

