Ore Preparation Plant - Sinter Process

The integrated steel works at Scunthorpe provides steel to construction, energy, shipbuilding and engineering industries worldwide.

Hot metal

Iron (hot metal) produced at Scunthorpe's iron works is further refined at the works steelmaking plant before being rolled at one of its rolling mills into various structural sections including plate, wire rod, angles, channels and beams.

Hot metal is produced by the blast furnaces from a combination of iron ore, coke and limestone. It is the careful blending and processing of raw materials, prior to charging into the furnaces, that allows process efficiencies and product quality to be achieved.

The blending and processing of the raw materials takes place at the Ore Preparation Plant (OPP), which incorporates a blending plant, coal preparation plant and sinter plant.

As part of an review of its activities across the OPP, the company elected to modernise the process control, visualization and data acquisition technologies applied at the sinter plant, and in particular those associated with the "sinter hood" or ignition furnace.

The sinter plant is a critical path process that continuously provides feedstock to the blast furnaces. Sintering is a production process whereby small particles coalesce to form larger masses, usually at high temperature.

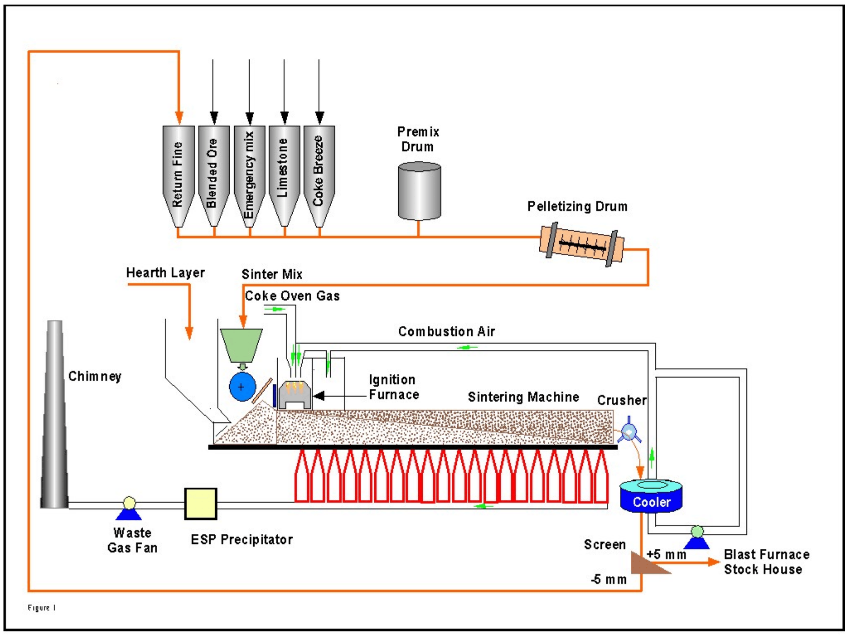
This process benefits the blast furnace operation, as sintering avoids losses which would otherwise occur if the iron ore, coke and limestone were fed into the blast furnace in a loose or powdered state.

At Scunthorpe there are two sinter lines, referred to as strands. Each strand is 4.2 metres wide x 0.55 metres deep and 72.0 metres long and processes 7,000 tonnes per day of sinter. Each strand has a sinter hood configured with six burners.

Critical to the sintering process is the control of the sinter hood, it's associated burners and the temperature within the furnace. Loss of the furnace will stop the process and fluctuating temperatures affect the quality of the product produced.

With reference to the process diagram (figure 1), the required blend of raw materials is first pelletized and then passed beneath the sinter hood, where it is ignited at a temperature of 1080°C.

The sinter travels along the bed of the strand, and whilst doing so, air is sucked through by a very large (4.9MW) waste gas fan. This allows the sintering process to continue to burn down through the bed. At the end of the sinter strand, the lumps of sinter are crushed to an optimised size for feeding the blast furnaces.



Process enhancement

When the company came to deciding how to approach the replacement of the sinter hood control system, careful consideration had to be given to the availability and reliability of the selected logic solver and the ease of use of the human operator interface for this direct fired, multiple burner application.

The replacement solution would employ a state of the art Supervisory Control and Data Acquisition (SCADA) system employing redundant servers and multiple client workstations distributed around various locations.

Each sinter strand would require the burner management sequence control and combustion control strategies to be taken out of the Ferranti computer and Honeywell based technologies and be engineered in a safety PLC technology in accordance with current best practice.

Each ignition furnace control system handles 320 digital signals, 80 analogue signals, multiple PID loops and numerous graphics based operator interfaces to depict the burner sequence and combustion control algorithms.

For the company safety is the number one priority and maintaining rigorous safety regimes and practices at the Sinter Plant is vital. It is important that any future control systems serve to maintain the high safety standards.

Good practice and proven partners

In this regard the company looked to apply the risk based methodologies and project life cycle described in Functional Safety standard EN61508 to guide the project and the devices employed.

Mindful of the safety implications associated with a hazardous process such as a furnace, and the significance of the sintering process to the Scunthorpe site, the company turned to Charter Tech, an independent integrator of Process and Safety Instrumented Systems (SIS). Charter Tech was acknowledged as having a proven track record in providing control solutions for this type of application.

The program would rollout in two phases, over a two-year period, with each phase completed within a strict shutdown period to minimize disruption to the sinter lines and consequently, the blast furnaces. Ultimately, the final system changeover and commissioning was accomplished within an intensive twenty four hour period. A longer "stop" period would require the temperature to be raised in the ignition furnace over many hours, during which time the production of one strand is lost.

To evidence that the logic solver (PLC) did not compromise the overall safety of the application, a TUV Rhineland, safety certified, PLC was specified by Charter Tech to control the safety-critical burner sequences.

In keeping with EN61508 "good practice" the non-safety critical combustion control signals are controlled and managed by a separate logic solver.

Evidencing compliance

Demonstrating compliance to EN61508 and evidencing the required risk reduction is accomplished using a safety file. The sinter plant safety file focuses on the BMS aspect of the project, which includes the failure rate data of the logic solver. This proves the PLC supports the target Safety Integrity Levels (SILs), determined for each Safety Instrumented Function (SIF). This documentary evidencing exercise also includes the compilation of clear and concise validation records pertaining to the hardware and software development tasks.

The company's Manufacturing Engineer remarked "Charter Tech have provided several complex safety critical burner management systems to us in the past, and it is their engineering competence along with their thorough understanding of EN61508 that has seen them chosen as the preferred supplier of the systems for this project".