Electric Arc Furnace (EAF)

An electric arc furnace used for steel making consists of a refractory-lined vessel, usually water-cooled, covered with a retractable roof. After charging the metal is melted using a set of graphite electrodes. The cycle is closed by pouring or tapping the resulting slag and steel.

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Slewing or Swivel bearing health

A gantry is used for moving the electrodes in and out the bath and/or for operating the lid of the reactor. The structure, and more specifically the swivel bearings also can suffer from extensive degradation. A dedicated monitoring coupling information about high-sensitivity acceleration data, electrical currents, inclination and/or temperatures in a smart way provides a way of continuous tracking gantry (bearing) health.

Busbar health

Busbars are used to transfer electrical energy to the electrodes. Due to the high currents involved this results in high vibrations and inductive coupling to other components. Monitoring of vibration levels and temperatures allows to reduce the chance for resulting mechanical or thermal damage.

Cooling system health

The cooling system is monitored through a continuous smart follow-up of pressures, flow rates and temperatures. An initial model depicting the relationships between the relevant parameters is trained. This model is running in the background to detect deviations in the relationships, indicating a potential onset of issues.

Structural dynamics vs. Process parameters

The melting process is a function of various operational parameters: electrical currents, composition and mechanical properties of primary materials, gas flow, vibrations, temperatures... Tracking all relevant parameters allows building up models separating 'normal' from 'abnormal' behaviour. Prolonged follow-up in turn allows identifying and quantifying changes in dynamic behaviour for similar process conditions, leading to early detection of damage development or process issues.

Energy efficiency

If electrical currents are tracked, material masses are determined based on our proposed combinatorial approach and temperature values are ingested, an additional level of follow-up can be obtained. combining all these data in a single intelligent system allows one to track with high precision, the energy efficiency of the melting process and how it evolves or changes as a function of additional process parameters.

Residual weight determination

To track the efficiency of the process and to see how material properties and process parameters influence it, mass balances represent an essential piece of information. By instrumenting the base structure of the EAF as well as the feeding system and internal transport tools in a smart way, one can continuously monitor this balance. Combining this with operational data from the local data Historian, the process can be improved significantly.

Tapping process deviations

One can track mass balances and compare weight before and after tapping. During the process also bearings and vibrations can be followed-up. Combining all these data streams the tapping process itself can be followed up and deviations or anomalies can be detected in an early stage, providing a way to prevent more significant problems or outages.

Process deviations

Using the data available in the Historian or SCADA system the operation of the EAF is continuously parametrised. Of interest are for example water flows, temperatures, electrical currents... The different stages of the process are automatically identified and when properties start deviating or unexpected values are detected, a warning is sent. The follow-up is based on process knowledge as well as models trained on the behaviour of the specific asset followed.

Electrode health

The electrodes are used to transfer the electrical energy into the furnace and start melting the metal. During this process, the electrodes undergo a lot of force. Based on the properties of the primary materials and the process parameters, the integrity of the electrodes or their support structure can be affected. Coupling information about vibrations, currents, inclination and/or temperatures in a smart way provides a way of continuously tracking electrode health.

Hot Heel

Controlling the Hot Heel is an important element in running smooth and efficient EAF operations. By applying an indirect monitoring system, the amount of liquid heel can be established on-line after each tap. As such operators and process engineers can collaborate on further streamlining the plant operations.

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