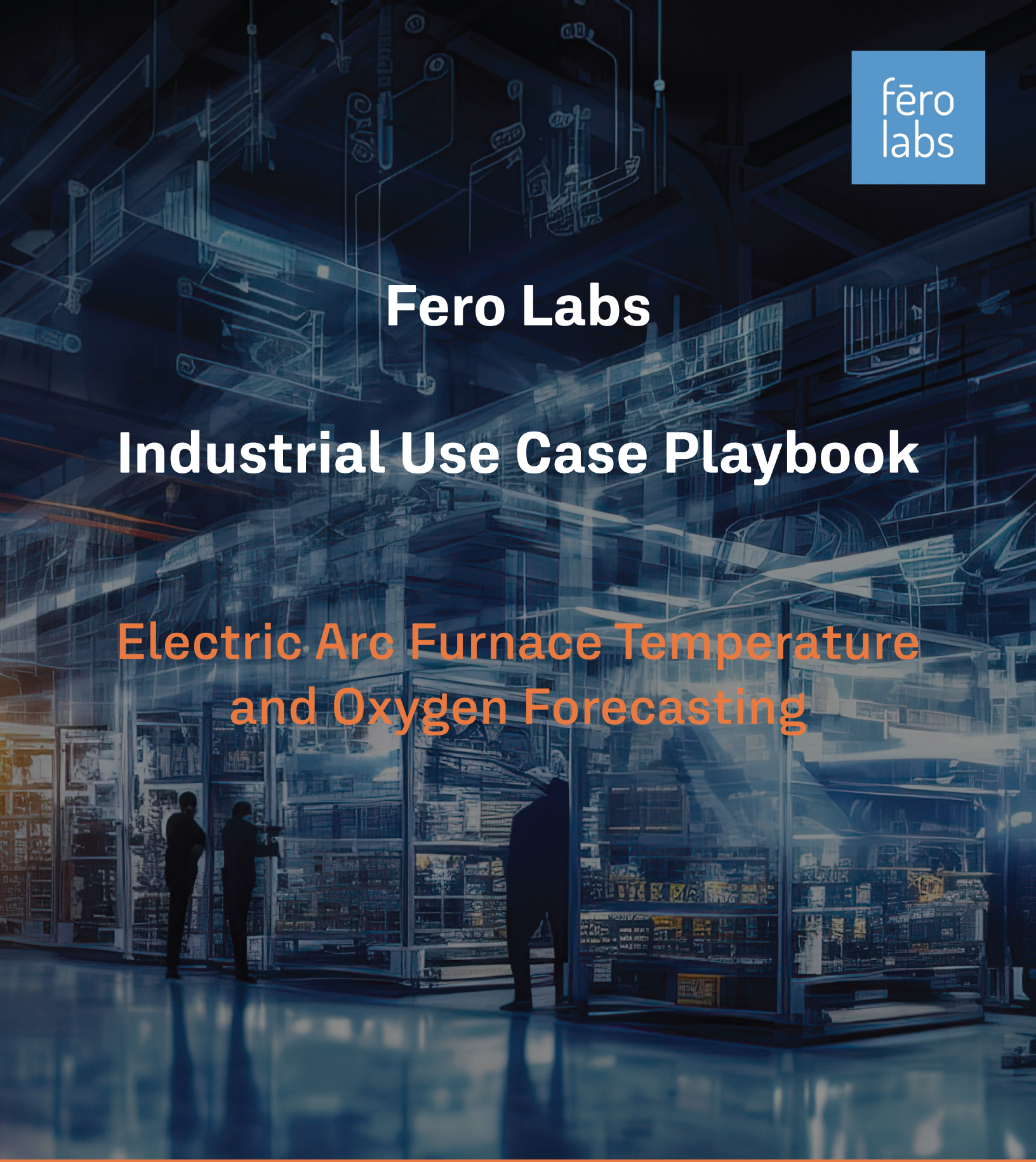

Fero Labs

Industrial Use Case Playbook

Electric Arc Furnace Temperature and Oxygen Forecasting

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Introduction

Welcome to the **Electric Arc Furnace Temperature and Oxygen Forecasting playbook**, designed specifically for steel manufacturers seeking to enhance process control, optimize energy consumption, and improve product quality. In the steel manufacturing sector, where precision and efficiency are paramount, the ability to accurately forecast and control temperature and oxygen levels in electric arc furnaces (EAFs) is essential for achieving desired steel chemistry and metallurgical properties.

Steel manufacturers operate in a highly competitive landscape, producing a diverse range of steel products crucial for various industries, including construction, automotive, and infrastructure. EAFs serve as vital assets in modern steelmaking, offering flexibility and efficiency in melting and refining scrap steel into high-quality molten metal.

However, predicting and controlling temperature and oxygen levels within EAFs present significant challenges, as these factors directly influence steel quality, process efficiency, and energy consumption. Variations in scrap composition, electrode positioning, and energy input can impact furnace performance and product consistency, necessitating advanced forecasting techniques and real-time monitoring solutions.

In this playbook, we delve into the methodologies, best practices, and technologies involved in Electric Arc Furnace Temperature and Oxygen Forecasting. By leveraging historical process data, advanced modeling techniques, and real-time monitoring systems, steel manufacturers can anticipate temperature fluctuations and oxygen concentrations accurately, enabling proactive adjustments to maintain process stability and product quality.

Through strategic implementation of forecasting initiatives and data-driven decision-making, steel manufacturers can unlock new opportunities for operational excellence, energy efficiency, and sustainability. Join us on this journey as we explore the principles and applications of Electric Arc Furnace Temperature and Oxygen Forecasting, empowering you to optimize your steelmaking processes and achieve new levels of performance and competitiveness in the industry.

Industry Overview

In the steel manufacturing sector, precise control over process parameters is essential for ensuring product quality, optimizing energy consumption, and meeting production targets. Steel manufacturers operate in a dynamic and competitive environment, producing a wide range of steel products crucial for various industries, including construction, automotive, and infrastructure.

Electric arc furnaces (EAFs) play a central role in modern steelmaking, providing a flexible and efficient means of melting and refining scrap steel into high-quality molten metal. The operation of EAFs requires careful monitoring and control of temperature and oxygen levels to achieve desired steel chemistry and metallurgical properties.

However, predicting and controlling temperature and oxygen levels in EAFs pose significant challenges for steel manufacturers due to the complex interactions between process variables, raw materials, and equipment dynamics.

One critical aspect of optimizing EAF operations lies in **Electric Arc Furnace Temperature and Oxygen Forecasting strategies**. This approach involves leveraging historical process data, advanced modeling techniques, and real-time monitoring systems to forecast temperature and oxygen levels during steelmaking processes accurately.

By analyzing key process parameters, such as scrap composition, electrode positioning, and energy input, steel manufacturers can develop predictive models to anticipate temperature fluctuations and oxygen concentrations, allowing for proactive adjustments to maintain process stability and product quality.

Electric Arc Furnace Temperature and Oxygen Forecasting not only enhance process efficiency and product quality but also contribute to cost reduction and energy conservation. By optimizing furnace operations, manufacturers can minimize energy consumption, reduce scrap loss, and improve overall process reliability. At Fero Labs, we refer to this as Profitable Sustainability.

Industry Challenges

In Industry 4.0, the promise of digital transformation often gets stuck in **"pilot purgatory,"** with **70% of initiatives failing to progress beyond testing phases**. McKinsey's research highlights that the choice of use case significantly impacts this phenomenon.

Selecting use cases that lack strategic alignment, clear value propositions, or encounter technical barriers contributes to pilot initiatives' failure.

Pilot purgatory not only wastes resources but also risks eroding confidence in digital transformation efforts. To navigate this challenge, organizations must strategically select use cases closely aligned with their objectives, offering clear pathways to value creation and scalability.

In each **Fero Labs Use Case Playbook**, we explore industrial use cases designed to address modern manufacturing challenges. Leveraging advanced analytics, AI, and machine learning, these use cases aim to drive tangible improvements in operational performance, cost-effectiveness, and sustainability.

By focusing on strategic and transformative use cases, organizations can break free from pilot purgatory and unlock new opportunities for growth and innovation.

Use Case Description

Background

An electric arc furnace (EAF) in a steel plant is a type of furnace that uses electricity to heat and melt scrap metal to produce steel. EAFs are used in the steel industry for their flexibility and efficiency in recycling scrap metal. The process involves charging the furnace with scrap metal and applying an electric current to create an arc between the electrodes and the metal, which melts the metal to the desired temperature for casting. Tapping — tilting the furnace to pour molten steel — should ideally happen as soon as the molten steel has reached its optimum temperature and oxygen composition.

Problem

Establishing fine control of end temperature and oxygen at the EAF is challenging. Measuring temperature and oxygen ppm content is typically only done periodically as probes cannot be placed inside the furnace for continuous measurement. Collecting temperature and oxygen measurements, often multiple times per heat, takes time and over the course of many heats, can reduce the operational throughput of a steel mill.

Precise control of EAF temperature and oxygen is crucial for maintaining steel output strength and adhering to specified standards. Overheating can damage the EAF lining, causing costly repairs and requiring cooling; wasting time and reducing production efficiency. Conversely, under-tapping may result in downstream complications necessitating re-heating and affecting final product quality.

Traditionally, operators adjust the EAF temperature by managing the power supply, relying on their experience, prevailing conditions, and empirical judgment. However, this approach can be subjective, inefficient, and cause fluctuations in operational quality.

Problem Summary

Establish precise control of EAF temperature and oxygen content to minimize tap variability and improve throughput.

Precise control of EAF tap temperature and oxygen content enables:

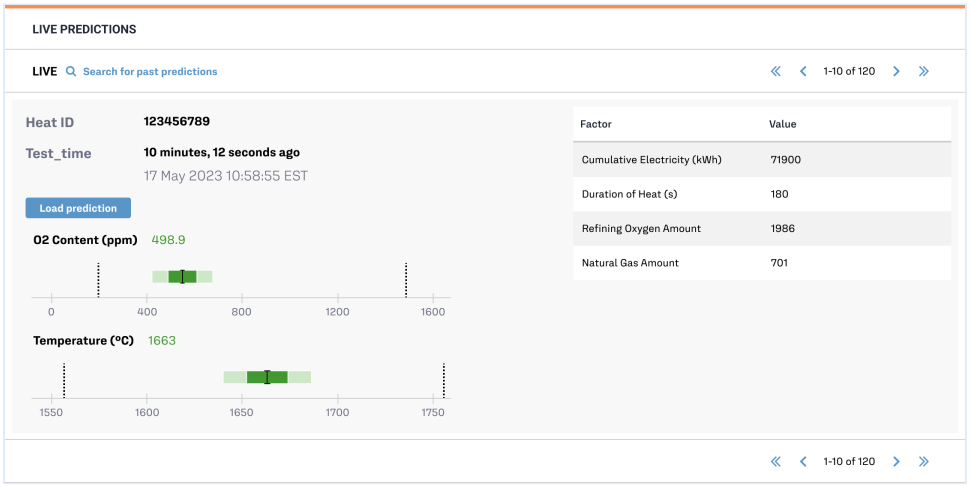
- Enhanced throughput through accurate temperature and oxygen predictions
- Decreased energy and gas consumption by preventing overheating
- Streamlined operations with fewer temperature and oxygen measurements

Fero Labs Solution

Electric arc furnace operators can use Fero Labs software to predict internal furnace temperature and/or oxygen content at specific points during a heat cycle, relative to cumulative energy and gas input. Fero serves as a soft sensor for EAF temperature and oxygen measurement. Additionally, Fero Labs software can provide real-time recommendations for dynamic process control to enable:

- reduction of energy and gas consumption in the EAF,
- mitigation of the mill's environmental footprint,
- stabilizing operations by dynamic adjustments

A Live Fero Analysis for this use case presents a interface for **production and quality engineers** to monitor production and take action at any moment:



Process & Business Outcomes

Achieve optimum tap temperature faster

With Fero Labs acting as a soft sensor for temperature and oxygen content predictions, fewer temperature measurements need to be taken during production. With Fero reducing the time to reach optimal tap temperature, EAF operators can expect an up to **1.5% increase** in throughput.

Energy cost minimization through dynamic operations

With Fero optimizing each batch of steel and providing dynamic process recommendations, stabilizing the process leads to reduced energy consumption. This can result in **up to 2% reduction** in energy consumption.

Commensurate reduction of Scope 2 emissions and carbon tax costs

With Scope 2 emissions making up 20–50% of EAF steelmaking's carbon footprint, operators using Fero can expect to see a **5 kg CO2e** per steel ton reduction. This correspond to six-digit annual savings in geographies subject to a carbon tax. Fero can provide reporting capabilities that directly track and account for this savings.

Fero Labs Adoption Timeline

EAF mills with specialized teams can collaborate to set up and deploy Fero. Below is a timeline highlighting typical steps. With Fero's easy-to-use, no-code interface, this can be achieved in a matter of weeks, not months or years.

Time	Process & Quality Engineers	Data Scientists / IT	Operators	Management
Week 1	Pull data	Pull data		
Week 1	Upload to Fero			
Week 1	Configure Fero	Configure Fero		
Week 2	Corroborate results	Receive example report showing accuracy		
Week 2	Set up Fero Optimization	Set up Fero Optimization		Receive example report showing savings
Week 3	Live data connection	Live data connection		
Week 3	Live Optimization screen (Detailed view)		Live Optimization screen (Simplified view)	
Going forward	Monitor deployment		Follow Fero Optimization recommendations	Receive regular reports showing savings
Going forward	Run "what-if" scenario simulations, spot check production, run root cause analyses		Follow Fero Optimization recommendations	Receive regular reports showing savings

Use Case Data Requirements

The Fero Labs Platform has convenient integrations into common process information management systems, such as Aveva PI System, AspenTech, Wonderware, and SQL databases, as well as laboratory information management systems, such as SAP, Oracle, and other ERP systems. Initial data exploration can be done either through direct integration into these services, or data file uploads in Excel and CSV data formats.

The data requirements for this use case typically involve the following sources:

Temperatures probe data

- Temperature probe data by sample per batch, including measured temperature and oxygen content of the heat.

Melt shop production data

- EAF and Process readings for each heat sample, including cumulative electric energy input, the duration, flxues in carbon, gas, oxygen, etc.

Activating This Use Case

Consider our **Industrial Use Case Playbooks** as inspiration and tactical ideas for your team to align on to maximize the efficiencies of your plant. Each Playbook has a matching **Use Case Blueprint** which provides detailed steps to activate each use case within the Fero Labs platform.

If you're curious to see these in action please book a use case demo with our team!

Together, let us continue to push the boundaries of what's possible, driving towards a future where industrial manufacturing is not just efficient and sustainable but truly transformative in its impact on society and the world at large.

Thank you for joining us on this journey, and we look forward to continuing to partner with you in your pursuit of excellence.

Sincerely,

Fero Labs

About Fero Labs

Fero Labs helps factories work better together by bridging the gap between the disconnected goldmine of production data and industrial knowledge inside every plant.

The Fero Labs Profitable Sustainability Platform collects data and knowledge, and augments it with powerful Fero ML so factories can make more confident changes that drive profit and sustainability.

Harnessing Fero Labs, a factory creates an augmented workflow which allows for better use of raw and recycled materials, production time, and energy utilization. Teams can work 90× faster, using Fero's AI powered simulated predictions or live optimizations. They can run root cause analyses in minutes, and make continuous process improvements that drive Profitable Sustainability.

Fero Labs's white-box explainable ML makes decisions clearer by showing the context and confidence levels behind every prediction and recommendation. This expands a plant's production knowledge and drives better production results for manufacturers, all while minimizing emissions. Together we'll build a sustainable tomorrow.