Fero Labs

Industrial Use Case Playbook

Fuel Rate Minimization

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Introduction

Welcome to the **Industrial Use Case Playbook**, crafted by **Fero Labs** for the forward-thinking professionals dedicated to enhancing factory production optimization.

Whether you're a Data Scientist, Process or Production Engineer, Metallurgist, or Plant Manager, this playbook is tailored to equip you with the strategies, insights, and tools necessary to drive transformative change within your organization.

In today's rapidly evolving industrial landscape, maximizing production efficiency and minimizing operational costs are imperative for maintaining competitiveness and sustainability.

Within each of our industrial playbooks, we present a curated collection of use cases designed to address the specific challenges faced by modern manufacturing facilities. Each use case is meticulously crafted to deliver tangible outcomes, ranging from increased productivity and quality to reduced waste and energy consumption to help achieve sustainability goals.

Featured within these pages is a use case which spotlights **Fuel Rate Minimization for blast furnaces in steel plants.** This case exemplifies how to tackle complex production optimization challenges head-on, leveraging data-driven approaches to drive measurable improvements in operational efficiency and cost-effectiveness.

As you embark on this journey for operational excellence, we encourage you to approach each Fero Labs use case scenario with curiosity, a willingness to embrace innovation and change.

By harnessing the power of your production data, domain knowledge, and collaborative problem-solving, we believe that you can unlock the full potential of your factory's production capabilities.

Together, let's redefine what's possible in industrial manufacturing and pave the way for a future of unprecedented productivity and sustainability.

Welcome aboard,

Fero Labs

Industry Overview

In the realm of industrial manufacturing, particularly within the steel production sector, optimizing production efficiency holds paramount importance in sustaining competitiveness and driving profitability. Steel plants, characterized by their intricate processes and heavy reliance on energy-intensive operations, face a myriad of challenges ranging from fluctuating market demands to **rising operational costs** and **stringent environmental regulations**.

Steel production stands as a cornerstone of global infrastructure, serving as a fundamental building block for construction, automotive, machinery, and countless other industries. According to industry reports, the global steel production reached over 1.8 billion metric tons in 2020, underscoring its indispensable role in modern society's infrastructure and economic development.

However, the steel manufacturing process is **inherently resource-intensive**, with significant energy and raw material consumption contributing to both economic and environmental impacts. Blast furnaces, a primary method for steel production, rely on the **precise control** of fuel rates to achieve optimal temperature and chemical reactions necessary for smelting iron ore into molten metal.

One critical aspect of steel production optimization lies in **minimizing fuel rates for blast furnaces.** Efficient fuel rate management not only reduces energy consumption and operating costs but also minimizes greenhouse gas emissions and environmental footprints associated with steelmaker processes.

Optimizing fuel rates in blast furnaces represents a key imperative for steel plants seeking to enhance operational efficiency, minimize production costs, and mitigate environmental impacts.

By adopting a data-driven approach with machine learning, manufacturers can gain insights into optimal fuel rate settings, and process parameters, and operational practices, enabling precise control over steel production while minimizing resource consumption and environmental footprint.

Moreover, in an era marked by growing sustainability concerns and regulatory pressures, optimizing production efficiencies not only yields economic benefits but also aligns with broader environmental objectives.

By reducing energy consumption, minimizing raw material usage, and optimizing waste management practices, steel plants can demonstrate their commitment to sustainable manufacturing practices while enhancing their bottom line. 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

Blast furnace steelmaking involves heating iron ore, fuel (typically coke), and limestone in a blast furnace to produce molten iron. The molten iron is then combined with oxygen (and optionally scrap steel) in a basic oxygen furnace to oxidize impurities and produce steel. This is currently the dominant process for primary steel production worldwide.

Problem

Minimizing the fuel rate in blast furnace steelmaking can maximize the blast furnace's energy efficiency and minimize emissions. By decreasing the amount of fuel used per ton of hot metal produced, the blast furnace's overall energy efficiency is increased. This helps lower the operating costs. It also lowers the carbon dioxide and other emissions generated from the combustion of the fossil fuel.

Controlling fuel rate is challenging because blast furnace process chemistry and transport phenomena are **too complex to analyze with simple physics-based models**. Direct measurements of hearth temperatures are not possible and casting time for typical blast furnaces is measured in hours, adding operational challenges to controlling such furnaces.

Process engineers study Silicon content in hot metal as a proxy to blast furnace temperatures. Higher temperature generally produce hot metal with lower Silicon levels. Increased Silicon levels can indicate unexpected cooling and can be addressed by increasing fuel rates.

Problem Summary

Minimize fuel rate by predicting Silicon content in hot metal, with respect to all other operating conditions of a blast furnace. Take proactive action rather than reacting to out of specification Silicon measurements.

The current solution is to react to Silicon measurements, which reflect blast furnace conditions from up to 10 hours ago. This leads to reactive course correction, which results in:

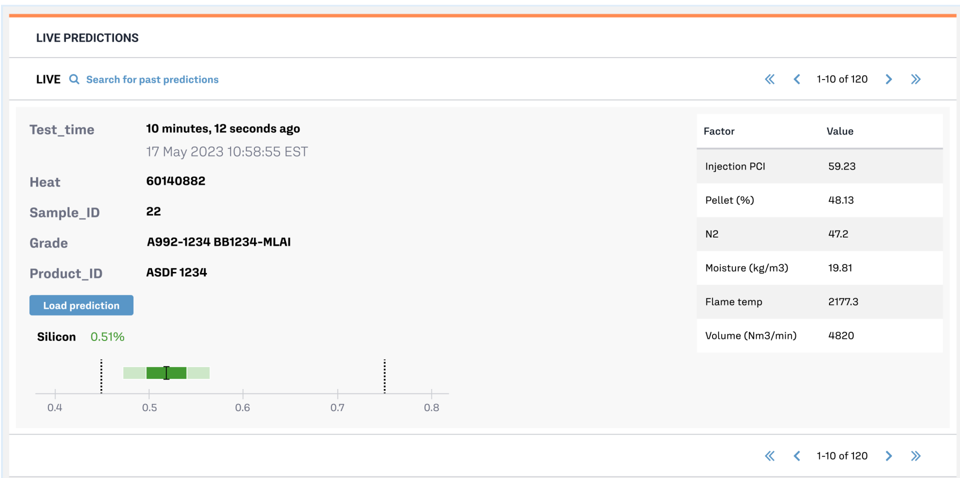
- financial loss due to unnecessary usage of fuel, combined with blast furnace cooldown risk, and
- environmental cost of incurring Scope 1 emissions due to unnecessary combustion of fuel.

Fero Labs Solution

Blast furnace operators can deploy the Fero Labs software to forecast Silicon content of hot metal, filling in the “gaps” between the 8–10 hours at which they sample the hot metal and analyze it. This real-time forecasting provides visibility into blast furnace hearth temperatures and guides operators to reduce fuel rates in a safe and predictable manner.

A Live Fero Analysis for this use case presents one easy-to use screen:

- For **process engineers** to monitor production and **operators** to take action at any moment.



Process & Business Outcomes

Tightened blast furnace temperature control and stability

With the Fero Labs platform providing forecasts for hot metal Silicon content, variability in fuel-stock, input ore, and operational parameters no longer translate to hot metal temperature variation. Since process engineers and operators gain access to predictions as early as **8 hours ahead of time**, they can proactively adapt rather than react to hot metal temperature fluctuations.

With a full adoption of Fero on the production line, blast furnace operators can achieve up to **20% reduction** in hot metal Silicon variability.

Fuel rate minimization across fuel types

Blast furnace operators seek to reduce fuel rates while incorporating increased amounts of pulverized coal. Overly aggressive reduction campaigns increase the risk of overcooling. In turn, high Silicon levels for some speciality steel can cause downstream obstacles. With Fero Labs providing high-accuracy forecasts of Silicon content, blast furnace operators can see a **5% decrease** in coke consumption across multiple product grades.

Measurable cost savings from fuel rate reduction

Reacting to hot metal Silicon content and temperatures leads to a consistent overuse of fuel to maintain hearth temperatures at sub-optimally high levels. With Fero providing visibility into this part of the furnace, operators can proactively drive the furnace.

With a full adoption of Fero on the blast furnace, an average sized furnace operator can expect **up to 3%** in fuel cost savings.

Commensurate Scope 1 carbon and ammonia minimization

Reducing fuel consumption directly reduces the Scope 1 carbon footprint of steelmaking. Since Scope 1 accounts for the majority (75+%) of direct steelmaking, reducing fuel rates leads to a commensurate **3.5–4%** reduction in Scope 1 and ammonia emissions. Fero Labs can provide reporting capabilities that directly track and account for this reduction.

Fero Labs Adoption Timeline

Blast furnaces 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 savings
Week 2	Set up Fero Prediction	Set up Fero Prediction		
Week 3	Live data connection	Live data connection		
Week 3	Live Prediction screen		Live Prediction screen	
Going forward	Monitor deployment	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:

Laboratory silicon analysis data

- Hot metal silicon content, analyzed as frequently as operations permit.

Blast furnace process data

- Sources include: top gas production data, blow air production data, temperature data, ore data and fuel data.
- All measurements should be timeseries data, measured ideally once every 10 to 20 minutes.

For more specifics on ideal data requirements for this use case make a time to chat with our team.

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 Augmented Intelligence 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 Lab'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.