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Fero Labs

Industrial Use Case Playbook

Ferroalloy Additive Minimization

Table of Contents

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 **Ferroalloy Additive Minimization for electric arc 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. Electric arc furnaces (EAFs), a prevalent method for steel production, rely on the **precise control** of alloy additives to achieve desired metallurgical properties and quality standards.

One critical aspect of steel production optimization lies in the **efficient utilization of ferroalloy additives within electric arc furnaces.** Ferroalloys, such as ferrosilicon, ferromanganese, and ferrovanadium, play a crucial role in refining the steel composition, enhancing its mechanical properties, and achieving desired chemical specifications. However, excessive use of ferroalloy additives can lead to unnecessary costs, increased waste generation, and environmental concerns.

Optimizing ferroalloy additive usage 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 additive dosages, alloy compositions, and process parameters, enabling precise control over steel quality while minimizing resource consumption and waste generation.

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

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.

Problem

One of the key goals in steelmaking is to ensure that mechanical properties are kept within specifications. This is hard to achieve since there is **a large variability in the chemical composition of scrap** that is used as input to the process.

To process each batch of scrap metal, various ferroalloys are added at the ladle furnace. These additions at the ladle furnace are critical to adapting to variable scrap chemistry and meeting product quality metrics. **Process and quality engineers** operating at EAF mills define static product recipes that aim to keep mechanical properties within specifications for a wide range of scrap variability. The challenge is compounded with rolling mill variability, cold-charge workflows, and annealing processes.

Examples of these ferroalloys are:

- Ferro-vanadium (FeV)
- Ferro-niobium (FeNb)
- Silico-manganese (SiMn)

Problem Summary

Minimize ferroalloy additives while maintaining mechanical properties (tensile and yield strength) within specification.

The current solution to this problem is to develop static grade-books (e.g., in an Excel document) for the worst-case scenario. These frequently advocate using a larger amount of ferroalloys than is necessary, which results in:

- financial loss due to unnecessary usage of key alloys, combined with a higher risk of scrap/regrade, and

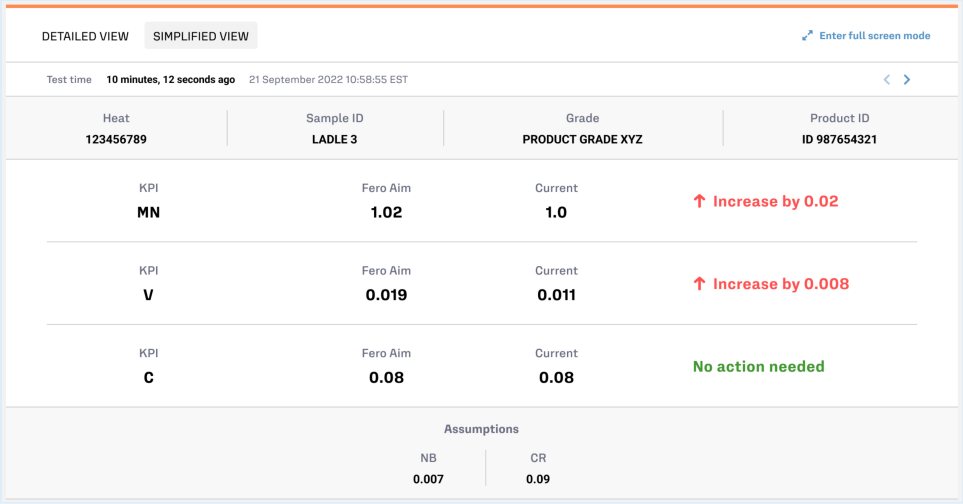
- environmental cost of incurring Scope 3 emissions due to the wasted raw materials.

Fero Labs Solution

Electric arc furnace operators can use Fero Labs software to minimize the addition of ferroalloys while ensuring that Tensile and Yield Strength KPIs are kept within product specifications. Worst-case rolling mill parameters can be used to minimize risk of product re-grades.

A Live Fero Analysis for this use case presents two screens:

- Detailed View: for **production and quality engineers** to monitor production and take action at any moment
- Simplified View: for **operators** in ladle pulpits, with critical information clearly presented.



Process & Business Outcomes

Tightened variation of end-of-line mechanical properties

With Fero Labs providing optimal recommendations for ferroalloy additions at the ladle, scrap variability no longer translates to end-of-line mechanical property variation. Since each batch is optimized to meet its specific quality metrics relative to its specific chemical composition at the ladle, Tensile and Yield Strength measurements become more stable.

With a full adoption of Fero Labs software on the production line, EAF mills can see up to **20% reduction** in Tensile and Yield Strength variability, within production grades. Knowing that production will reliably meet its specifications leads to smoother operations.

Increased proportion of scrap in production

With high-grade steelmaking, it can be difficult to rely solely on scrap metal to hit specific chemistry targets and mechanical property specifications. Some EAF mills may blend scrap with direct steelmaking. With Fero optimizing each batch of scrap based on its chemical properties, EAF mills that blend scrap can expect up to a **25% increase** in scrap metal usage in production.

Measurable cost savings from minimizing ferroalloy consumption

Static recipes for product grades lead operators to add unnecessary amounts of ferroalloys at the ladle. With Fero optimizing for cost, while maintaining stability of end-of-line mechanical properties, operators can minimize what added ferroalloys.

With a full adoption of Fero on the production line, EAF mills can expect up to **2.8% cost savings** in raw materials.

Commensurate Scope 3 carbon footprint minimization

The minimization of ferroalloys tackles the tricky problem of reducing Scope 3 emissions. Since almost half of EAF steelmaking's carbon footprint falls into Scope 3, a reduction here can reduce the carbon footprint of production by **up to 15%**. Fero can provide reporting capabilities that directly track and account for this reduction.

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 savings
Week 2	Set up Fero Optimization	Set up Fero Optimization		
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:

Laboratory mechanical strength data

- Average tensile and yield strength measurements per batch or heat.

Melt shop production data

- Melt shop chemistry readings for each ladle sample, with product type and grade information.

(Optional) Rolling mill production data

- If available, rolling mill parameters, averaged by batch can help Fero Labs adapt to worst-case rolling mill settings at the ladle.

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.