Fero Labs

Industrial Use Case Playbook

Polyethylene Production Optimization

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, Quality 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 **Polyethylene Production Optimization for chemicals 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 chemical manufacturing, optimizing production processes is essential for maintaining competitiveness, meeting market demands, and maximizing profitability. Chemical manufacturers operate in a dynamic and diverse landscape, producing a wide array of products crucial for various industries, including plastics, automotive, construction, and packaging.

The global chemical industry serves as a cornerstone for economic development and innovation, providing essential materials for countless downstream sectors. Among the myriad of chemicals produced, polyethylene stands out as one of the most widely used polymers, prized for its versatility, durability, and cost-effectiveness.

Polyethylene (PE) production, however, poses significant challenges for chemical manufacturers due to its complex and energy-intensive processes. As a **key building block for plastics**, polyethylene production requires precise control over reaction conditions, raw material quality, and process parameters to ensure product consistency and quality.

One critical aspect of optimizing polyethylene production lies in **Production Optimization** strategies. This approach involves implementing advanced process control, predictive modeling, and data analytics techniques to enhance process efficiency, reduce production costs, and improve product quality.

By leveraging real-time monitoring systems, machine learning algorithms, and optimization algorithms, chemical manufacturers can optimize key process variables, such as temperature, pressure, catalyst dosage, and reactor residence time, to maximize throughput and minimize energy consumption.

Polyethylene Production Optimization not only enhances operational efficiency and cost-effectiveness but also contributes to sustainability goals by reducing resource consumption and environmental impact. By improving process efficiency, chemical manufacturers can achieve significant reductions in energy usage, waste generation, and greenhouse gas (GHG) emissions. 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

Polyethylene (PE) is one of the most widely-produced plastics, used in a range of applications including packaging, films, bottles, household goods, car parts, pipes and containers. PE manufacturers must continually modify their production processes to adjust to shifting market demands for different PE grades. Such adjustments can often lead to production of off-specification PE leading to waste and avoidable environmental damage.

Problem

Off-spec PE production is both wasteful and costly for plants. This issue primarily arises during transition periods between product grades, in which operational changes are made to meet market demands of specific PE grades. To mitigate the production of off-spec PE, **plant operators** will often store and blend off-spec product with PE that meet quality standards. However, managing the storing and blending of off-spec PE poses substantial challenges, particular when faced with an **excess accumulation of off-spec PE** and insufficient storage capacity. In such situations, the excess off-spec PE is directly discarded and sent for waste treatment. This management challenge is exacerbated by the fact that a single PE production plant may produce over ten different product grades, requiring frequent transitions and complicating the task of minimizing off-spec production.

Problem Summary

Ensure optimal polyethylene production to produce final product that meets specifications while reducing raw material usage and plastic waste through off-spec production

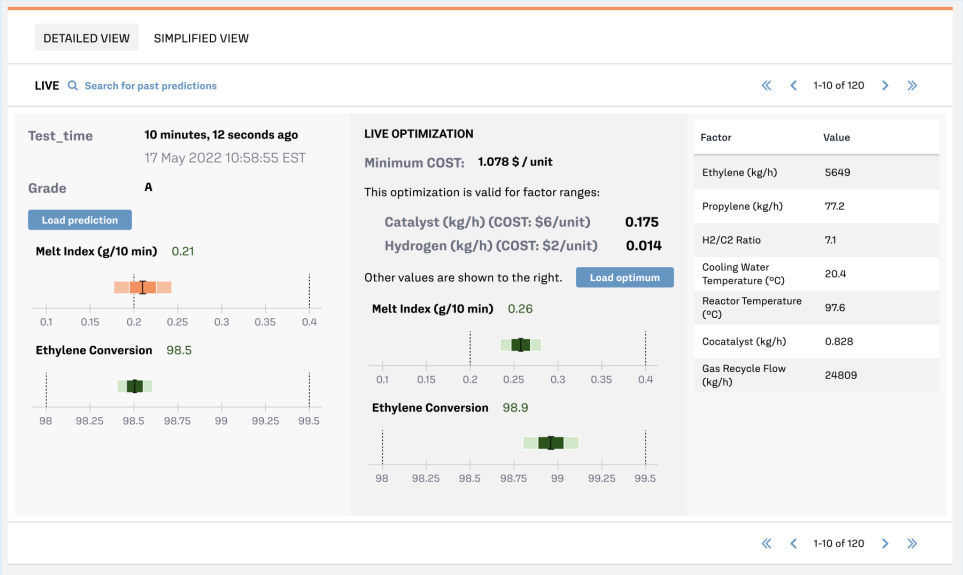
Identifying the optimal operating conditions during these transition periods is a complex task, especially since the typical interval between measurements of final product quality in a polyethylene plant (such as melt index and ethylene conversion rate) can range from **0.5 to 5 hours**. Between measurements, plant operators must rely on their expertise or follow established operational guidelines to ensure production meets specifications. This is further complicated by the numerous manipulated variables operators can control during production such as reactor temperature, monomer, comonomer, and chain-transfer agent concentrations. Additionally, they must account for time delays between upstream and downstream production when making these adjustments.

Fero Labs Solution

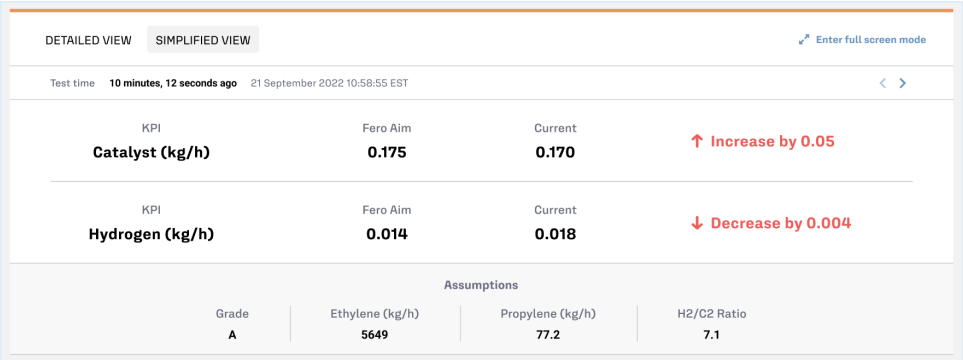
Optimizing operational parameters to promote in-spec production while reducing energy consumption can improve process efficiency and reduce the environmental footprint of PE production. Operators in polyethylene plants can use Fero Labs to predict the final product melt index and density and subsequently run optimizations to minimize the cost of raw material usage.

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. Fero can be used to perform real-time monitoring of plant performance by predicting the final quality of the polyethylene grade. During the time between lab measurements, the live prediction can also help with early detection of poor-quality product. Steps can then be taken to ensure production is brought back into specification quickly. These changes will minimize total cost of raw material (catalyst, hydrogen) while keeping PE melt index and ethylene conversion within specification for the specific PE grade.



- Simplified View: for **operators** in control rooms, with critical actionable information clearly presented for a specific PE grade.



Process & Business Outcomes

In-process optimization during product grade transitions

When deployed, Fero considers the varying operational changes made during product grade transitions throughout the production process to make predictions for specific PE grades. Operators receive real-time, cost-efficient recommendations for adjusting the process parameters to minimize the amount of off-spec production during transition. These recommendations also take into account time lags in measurements made at different stages of production.

With full adoption of Fero Labs software, plant operators can expect to experience up to **50%** reduction of off-spec during grade change transition and up to **30%** reduction in transition time.

Reduced plastic waste and minimize Scope 1 and Scope 2 footprint

Monitoring plant performance and predicting final product quality enable plant operators to minimize off-specification production, alleviating the operational challenge of managing excess off-spec PE and mitigating issues related to storage, waste, and environmental concerns. Minimizing off-spec PE accumulation through real-time optimization supports more **sustainable operations,** reducing the refinery's **Scope 1 carbon footprint** through waste reduction and lowering its **Scope 2 carbon footprint** by reducing the processing need to reworking an off-spec batch.

Fero Labs Adoption Timeline

Plants 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:

Laboratory Characterization Data

- Source: typically LIMS or ERP (e.g., SAP)
- Content: Melt Index, Ethylene Conversion Rate, Density, etc.
- Index: Indexed by time

Grade Specification Data

- Source: typically LIMS or ERP (e.g., SAP)
- Content: Lower Spec Limit (LSL) and Upper Spec Limits (USL) of PE quality metrics, etc.
- Index: Indexed by Grade

Process Production Data

- Source: typically PIMS (e.g., PI system, Aspen)
- Content: monomer, comonomer, chain transfer agent, catalyst, co-catalyst, activator, hexane, hydrogen, flow rates, flow ratios, reactor temperature, heat duty, recycle flow rates, etc.
- Index: Indexed by time

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 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.