Fero Labs

Industrial Use Case Playbook

Pesticide Batch Yield Maximization

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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, 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 **Pesticide Batch Yield Minimization for chemical manufacturers**. 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, maximizing batch yields is essential for **ensuring profitability, meeting market demand, and maintaining competitiveness**. Chemical manufacturers operate in a dynamic and diverse landscape, producing a wide range of products crucial for various industries, including agriculture, pharmaceuticals, and consumer goods.

Among the products manufactured, pesticides play a crucial role in crop protection and agricultural productivity. The global demand for pesticides continues to grow due to increasing population growth, expanding agricultural activities, and the need to enhance crop yields to feed a growing population.

However, achieving optimal batch yields in pesticide production poses significant challenges for chemical manufacturers due to the complexity of chemical synthesis processes, variations in raw material quality, and stringent regulatory requirements.

One critical aspect of optimizing pesticide production lies in **Batch Yield Maximization** strategies. This approach involves implementing advanced process control, optimization algorithms, and data analytics techniques to enhance process efficiency, reduce production costs, and improve product quality.

By analyzing key process parameters, such as reaction conditions, catalyst concentrations, and raw material characteristics, chemical manufacturers can identify opportunities to optimize batch yields and maximize production output.

Pesticide Batch Yield Maximization not only enhances operational efficiency and cost-effectiveness but also contributes to sustainability goals by reducing resource consumption and waste generation. By improving batch yields, manufacturers can achieve significant reductions in energy usage, raw material consumption, and greenhouse gas (GHG) emissions, thereby minimizing their environmental footprint. 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

Thiamethoxam is a broad-spectrum insecticide used for a variety of crops. Commercial-scale production of thiamethoxam involves the reaction of raw material, followed by distillation, and then crystallization. Thiamethoxam yield can depend on several factors including the molar ratios of raw materials entering the reactor, the duration of the reaction, the amount of catalyst, the amount of byproducts formed in the reaction, the pH of the neutralized solution, and the reactor and distillation operating conditions such as temperatures, pressures, and flow rates.

Problem

The yield of thiamethoxam can vary significantly, typically ranging from 65-90%. This variation is mainly due to variability in the composition of the raw materials and the operating conditions during each step of the synthesis and separation process.

Process and quality engineers in the plant must promptly identify the factors that could lead to lower than expected yields and determine how to modify process settings to mitigate these effects.

Problem Summary

Simultaneously optimize dozens of process condition to proactively maximize yield of pesticide production, while mitigating byproduct formation.

The current approach to address this issue is often through a Six Sigma-based method. The process engineer analyzes data to spot variations in raw materials or process conditions among the numerous indicators, or tags, within the customer's Process Information Management System (PIMS). However, these methods might not fully capture the complex interrelations between tags, potentially missing the root cause of the lower yields in a batch.

This oversight can result in several consequences:

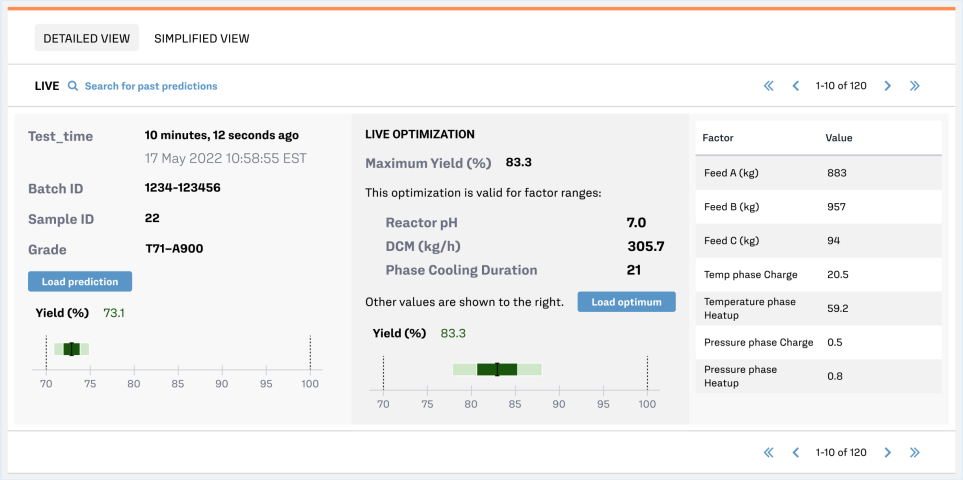
1. Financial loss stemming from the excessive use of raw materials and the need for extra handling of waste, such as solvents and undesirable byproducts.
2. Reduced revenue due to yields that fall short of expectations.
3. Prolonged periods spent on diagnosing the problem and applying modifications to the process.

Fero Solution

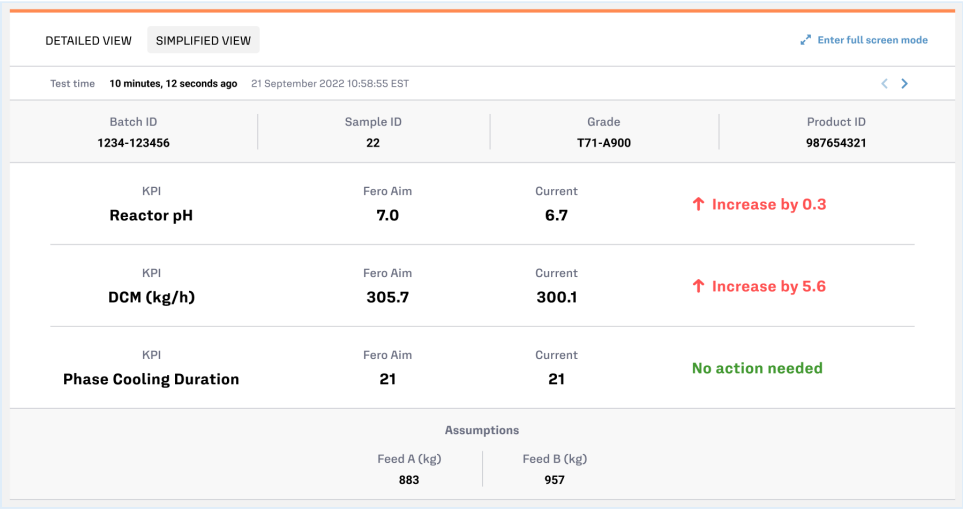
Plant operators can employ Fero to fine-tune operational parameters, ensuring high yield despite varying raw material compositions and operating conditions throughout the synthesis and separation processes. Fero provides the capability to predict and maximize the final product yield by optimizing the factors influencing yield. It also aids operators in pinpointing specific operating regimes that contribute to lower-than-expected yields, facilitating targeted process-level changes.

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

- Detailed View: for **plant operators** to monitor production and take action at any moment. Here, Fero recommends how yield can be maximized under current production conditions. Restrictions can be placed on the maximum or minimum allowed values for raw materials, enabling engineers to safely explore cost minimization objectives while continuing to maximize yield.



- Simplified View: for **plant operators** to know exactly what action to take to maximize yield and reduce raw material consumption.



Additionally, **process engineers** can use Fero's "Group Prediction Simulator" to simulate various "what-if" scenarios of process settings changes to increase the yield of historically low-yield batches.

Process & Business Outcomes

Optimize process parameters for maximum batch yields

Fero Labs equips operators with the tools to fine-tune each batch's process parameters. A full deployment of Fero across operations can improve yields by up to **10% per batch**.

Identify the root causes of lower-than-expected yields for targeted improvement

With Fero's Root Cause Explorer, plant engineers can swiftly identify which variables impact yield—often **within minutes**. Utilizing Fero enhances overall process comprehension, allowing the team to rapidly determine the most influential factors out of hundreds that affect batch yield and their impact on the relative change in yield.

Conduct 'what-if' simulations to gauge the effects of process modifications

Fero's Group Prediction Simulator lets the plant engineers test **hundreds of different "what-if" operating scenarios** for batches with low yields. This feature assists plant managers in adjusting relevant process set-points across the entire operation. Such adjustments can save plant engineers **several days or even weeks of analysis**, which can now be more efficiently addressed thanks to this feature.

Fero Labs Adoption Timeline

Plant 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	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, run group prediction simulator study		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:

Lab Analysis Data

- Source: typically LIMS or ERP (e.g., SAP)
- Content: Batch ID, raw material, pH, pesticide yield, etc.
- Index: Indexed by Batch ID

Reactor Process Data

- Source: typically PIMS (e.g., PI system, Aspen)
- Content: Batch Definition Tag, Phase Definition Tag, reactants, solvents, catalyst, pH neutralizing agent, reactor operating conditions, etc.
- Index: Indexed by time

Separator Process Data

- Source: typically PIMS (e.g., PI system, Aspen)
- Content: Separator operating conditions, pressures, temperatures, etc.
- Index: Indexed by time

Dryer

- Source: typically PIMS (e.g., PI system, Aspen)
- Content: Dryer operating conditions, drying agent parameters, 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.