

Distillation Tower Fouling Prediction: Anomaly Detection & Causality Analysis Using Using Process Health Solution (PHS)

Liberty Barney Data Scientist Ascend Performance Materials





## Distillation Tower Fouling Prediction: Anomaly Detection & Causality Analysis Using Machine Learning Ascend Performance Materials

#### Introduction

#### Ascend Performance Materials

- Headquartered in Houston, TX
- Global leader in integrated nylon production
- Global presence



#### Liberty Barney

- Data Scientist
- Artificial Intelligence, Automation, & Reporting Group



## Background - Distillation Tower Fouling

#### **Distillation Tower**

- Used to recover key raw material from process
- Fouls on an 18–24-month interval
- Foulant leads to operational issues
- Leads to a 7+ day maintenance outage for cleaning



#### Goals

- Predict fouling 3 months in advance to enable proper planning for downtime
- Identify key contributors to fouling to extend operation time between cleanings



#### Add-ons 🕆 🖌

#### ➡ Seeq ML Causality

Understand cause-and-effect process relationships and identify key actors

Journal

Create Asset Tree Create Asset Trees from CSV File

Email Notification Scheduler Data Lab Notebook-based Email Notification Scheduling tool

Condition Monitor Scheduler Data Lab Notebook-based Email Notification Scheduling tool with PDF attachment support

Seeq ML Create Build/Train a Seeq ML model

Seeq ML Apply Evaluate & Deploy

#### • SPC Accelerator

Create Statistical Process Control (SPC) control charts and apply run rules

#### 🖌 Worksheet Cloner

Creates a copy of a worksheet with new item IDs

#### 🗰 Seeq ML Signal Selection (Early

Preview) Determine signals that influence events for use in Seeq ML

## Approach - Seeq Process Health Solutions

- ML Causality
  - Root Cause Analysis
  - Regression Input Selection
- ML Create / ML Apply
  - Anomaly Detection
  - Signal Contributions
- ML Signal Selection
  - Identify & remove low variance signals
  - Identify & remove multicollinearity
  - Rank signal importance

## Approach - Identify Historical Fouling



## Identified 5 fouling events

Proved historical fouling metric <u>not</u> a reliable indicator of fouling



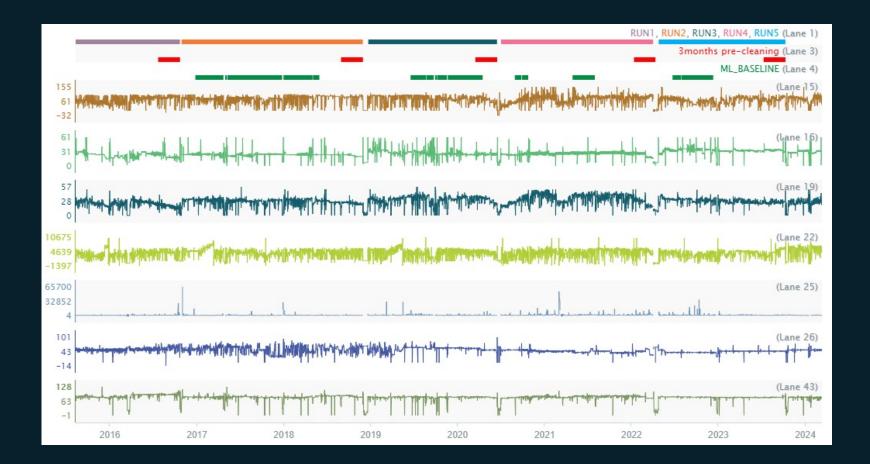
## Approach - Pull & Cleanse Data for ML

#### Data Preparation

- Data dump- 60+ signals
- Data cleansing
- Event characterization

#### Seeq ML Prep

 Identify "baseline" & "target" periods



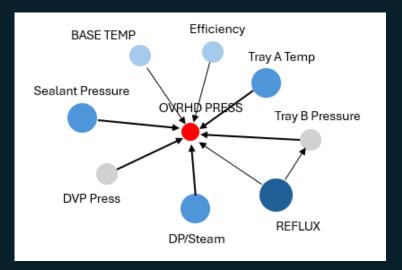
#### Approach— Seeq Signal Selection & Causality

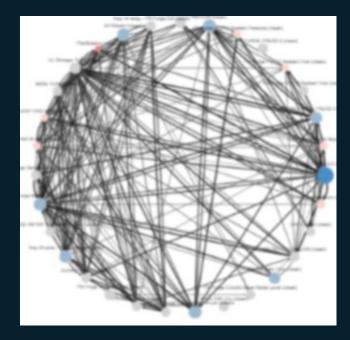
#### • Seeq ML Signal Selection tool

• Remove low variance & high multicollinearity

#### • Seeq ML Causality analysis

- Identify causal relationships
- Compare dynamics before/during/after fouling event



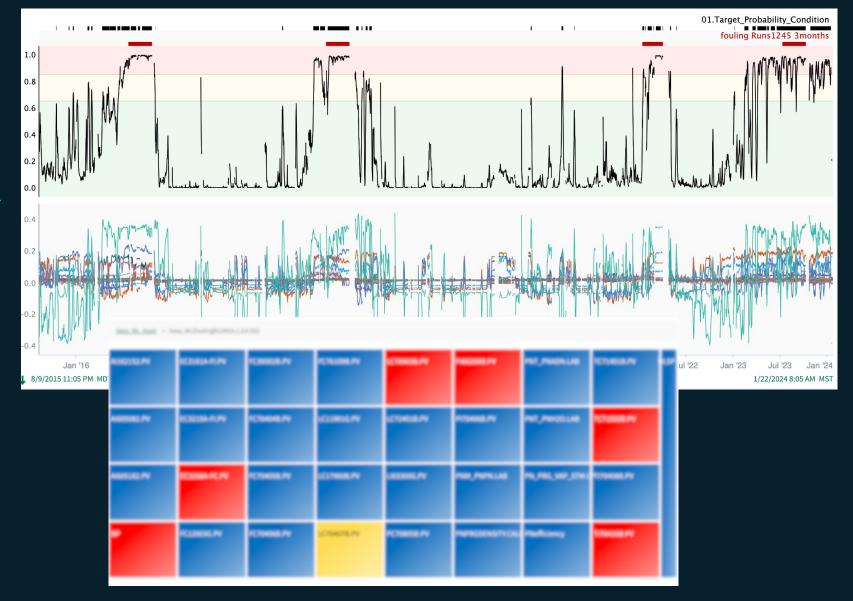


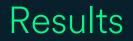


#### Approach - Seeq ML Anomaly Detection

Predicts need for maintenance with at least 60-day lead time

Identifies key contributors to anomalous behavior





Built a model that predicts need for downtimes at least 60 days in advance

Identified key contributors to fouling; Proposed operational changes to extend runtime between cleaning

Identified root causes of other non-fouling operational issues



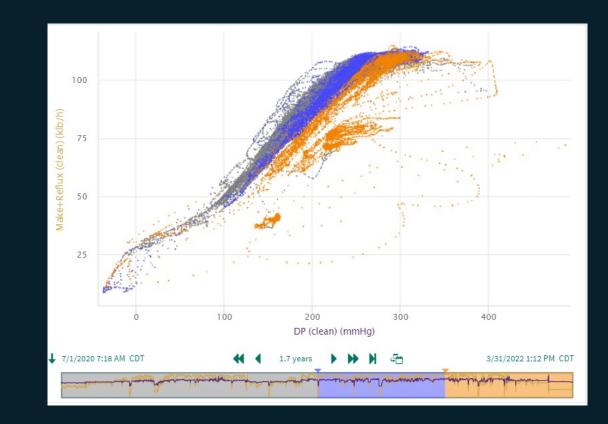
Next Steps

Operationalize models Dashboard, exception notifications

Carry out trials for proposed optimization to extend runs

Enhance distillation tower monitoring &

scale to all towers across enterprise



# Q & A

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Nelle.

# **Thank You!**



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