

Advanced Data Analytics for Predictive Maintenance of Carbon Black Manufacturing Plant

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Invasystems Overview

- Products and Solutions
 - Industrial IoT
 - Enterprise Mobility
 - Employee Engagement
- Digital and Cloud Services
 - OSIsoft's PI SYSTEM
 - Mobile App. Development
 - Microsoft Azure
 - SharePoint
 - Business Intelligence
- Enterprise Application Services
 - SAP
 - Oracle EPM and E-Business
 - Oracle Dell Boomi Integration

Chemicals

Oil & Gas

Power

Manufacturing



60+
Customers

8 Enterprise
Scale
Products

Invasystems : Solutions and Services

Enterprise Mobility

- Sales & CRM
- Distribution
- Loyalty
- Field Services
- Workflow
- Custom Apps
- SAP Fiori

Data analytics and BI

- ProcDNA
- PI System Services
- DiagnEASE
- Reporting and Dashboards
- Statistical Analysis

Microsoft Services

- Azure
- Sharepoint
- .NET

Augmented Reality

- Augmented and Virtual Reality

Enterprise Application services

- SAP
- Oracle E-Business
- Oracle EPM
- Dell Boomi

Invasystems and Orion: PI System Services

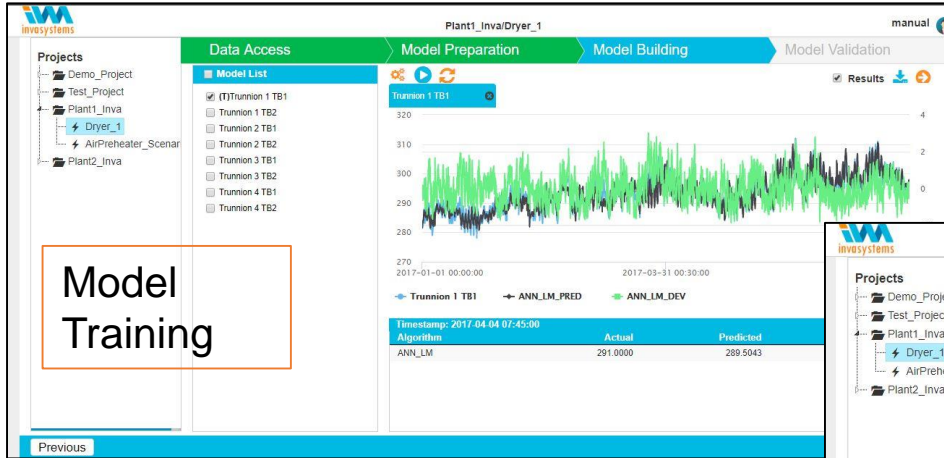
- Maintenance and Support for PI System
 - System Health-check
 - PI AF and Tags Management
- Support for Integrated Application
 - .Net Based Applications
 - Integrates SAP, PI Systems, Proprietary Engineering Application
- Advanced Data Analytics Solution for Predictive Maintenance

ProcDNA: Introduction

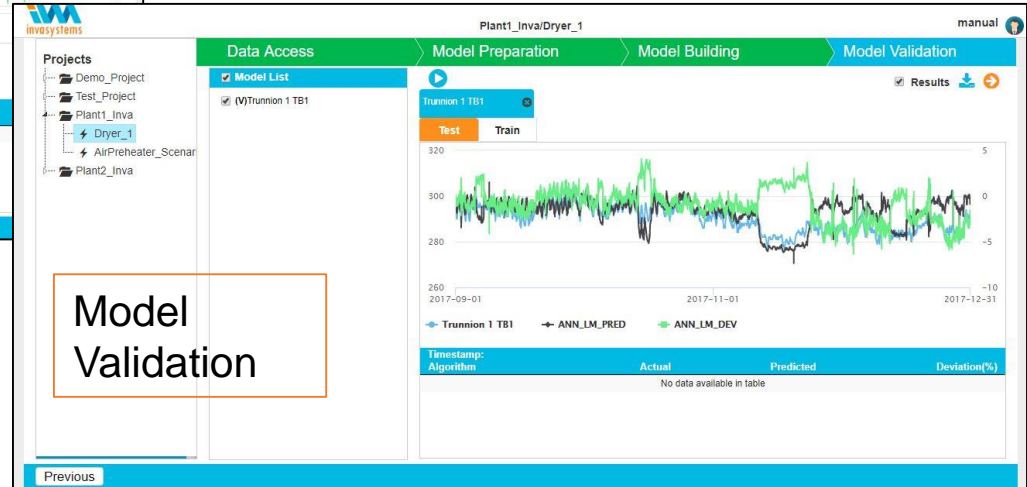
- Advanced Data Analytics Application
- Data Import
 - Seamless Connectivity with PI System
- Load Training and Validation Data Sets
- Statistical Analysis
- Trend Analysis
- Correlation Indices Analysis
- Analytics : Data Preparation
 - Variables Selection
 - Dependent and Independent Variables
 - Subject Matter Experts Play Pivotal Role
- Range Selection for Training



ProcDNA : Model Training and Validation

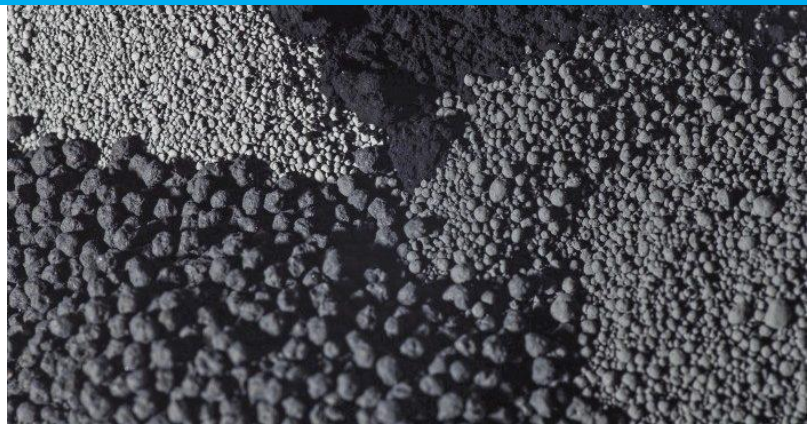


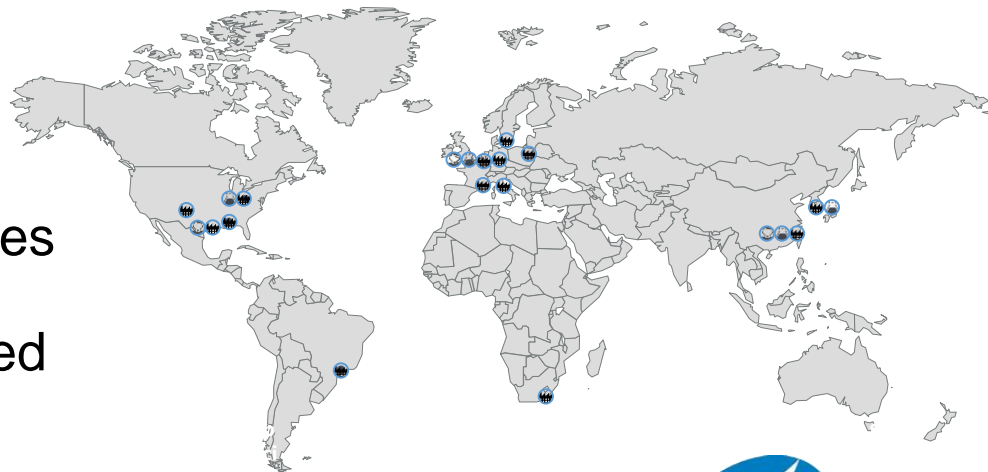
Predicted vs Measured % Deviations



Administrator Manages Deployment of Trained Model in Real Time Environment

- One of the world's leading suppliers of Carbon Black
- We offer high-performance products for Coatings, Printing Inks, Polymers, Rubber and other applications
- Our high-quality Gas Blacks, Furnace Black and Specialty Carbon Blacks tint, colorize and enhance the performance of plastics, paints and coatings, inks and toners, adhesives and sealants, tires and manufactured rubber goods





- With more than 1.400 employees worldwide we run 14 global production sites and four Applied Technology centers
- All production sites connected with one central PI server
- >45.000 tags
- Central AF server with 15 data bases
- Globally standardized Asset Framework
- Process data, quality data, ERP data



Reliability Initiative

Target



- Reduce downtime
- Better planning
- Extra lead time

Condition Monitoring



- Extend sensor usage
- Status information
- Dashboards

Predictive Maintenance



- Damage prediction based on process parameters
- Feedback into PI System as Prediction Status

Reliability Pilot Project

Condition Monitoring

- High level reliability status dashboards
- Detailed equipment dashboards
- Standard displays based on Asset Framework

Predictive Maintenance

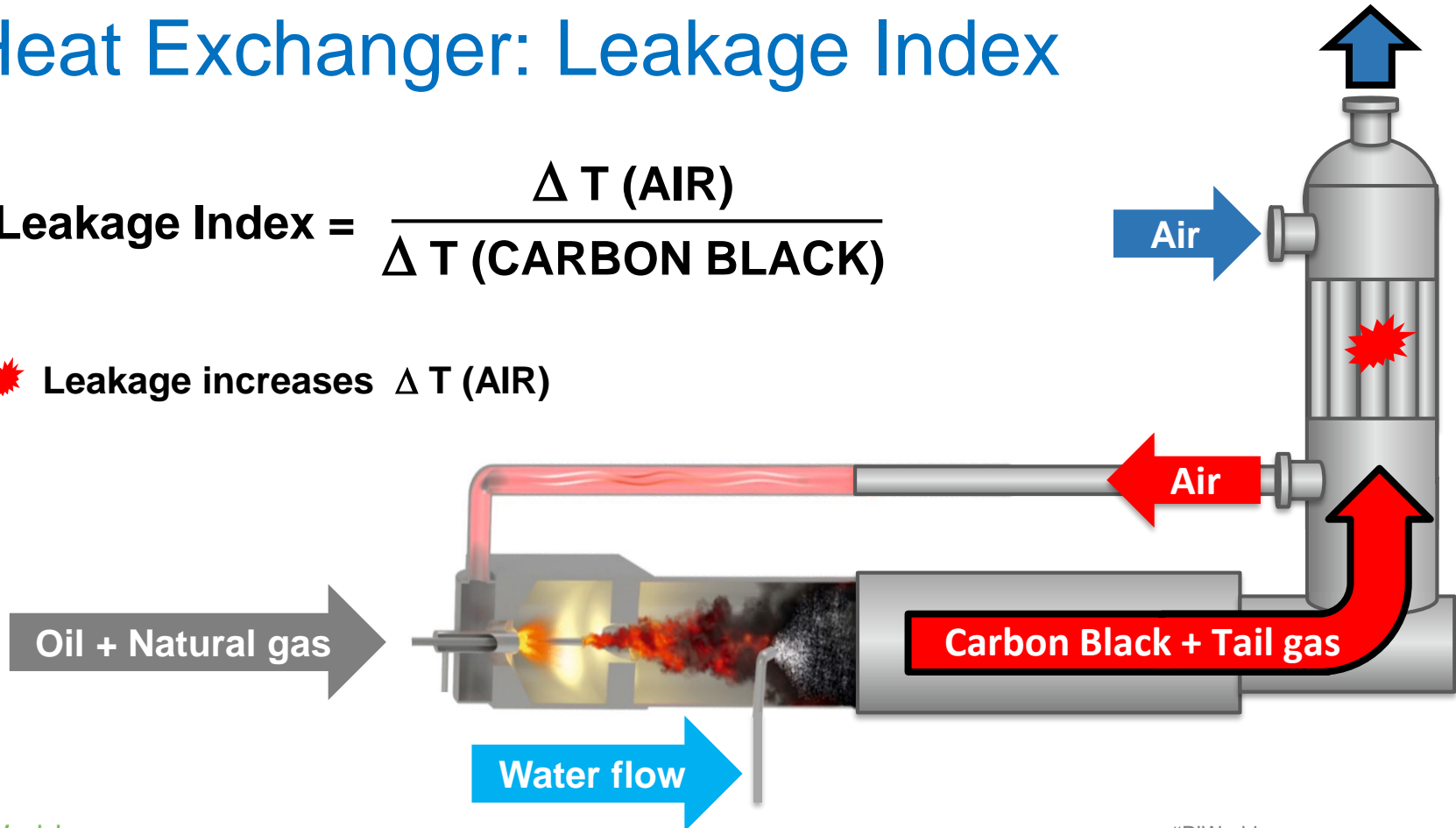
- Start of pilot phase in 2 plants: December 2018
- Prediction models for large scale **heat exchangers** and **rotary dryers**
- Data analysis
- Workshops for process understanding
- Models deployed May 2019



Heat Exchanger: Leakage Index

$$\text{Leakage Index} = \frac{\Delta T (\text{AIR})}{\Delta T (\text{CARBON BLACK})}$$

★ Leakage increases $\Delta T (\text{AIR})$

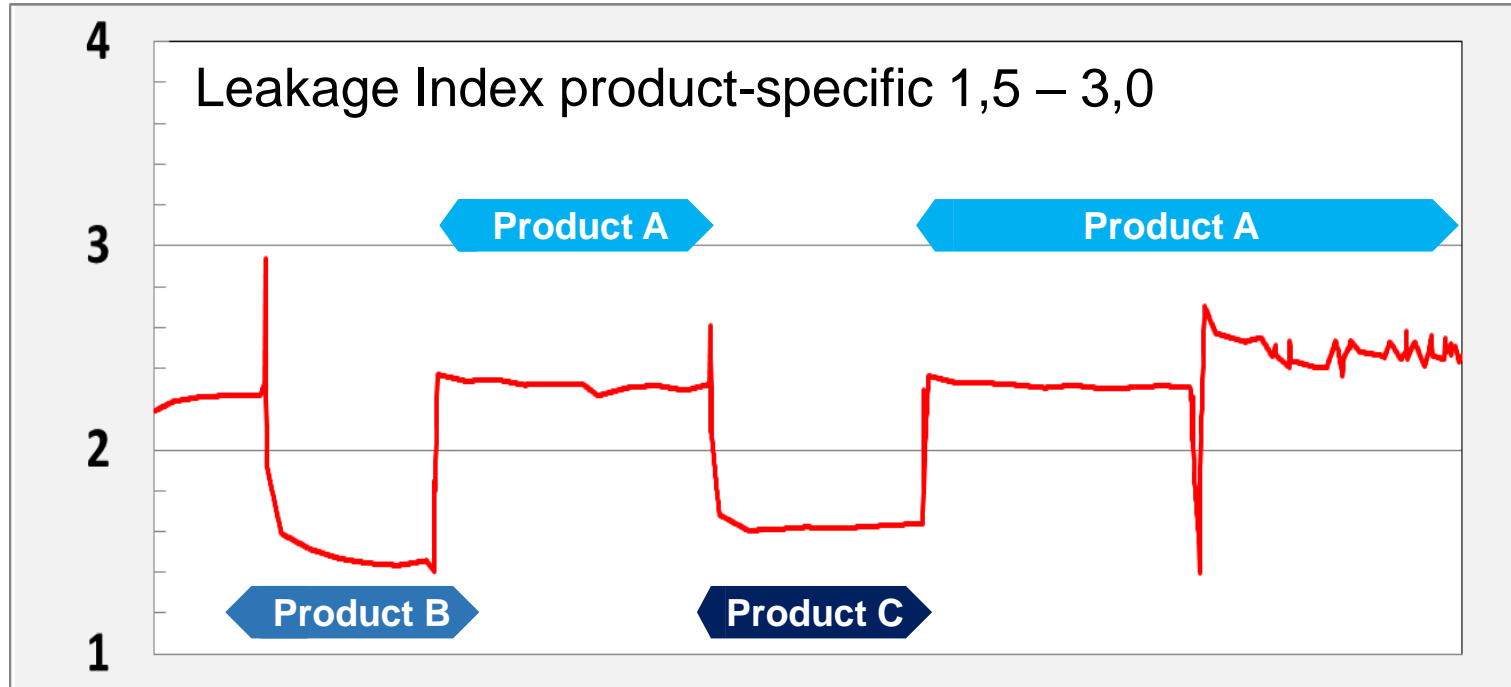


Heat Exchanger:

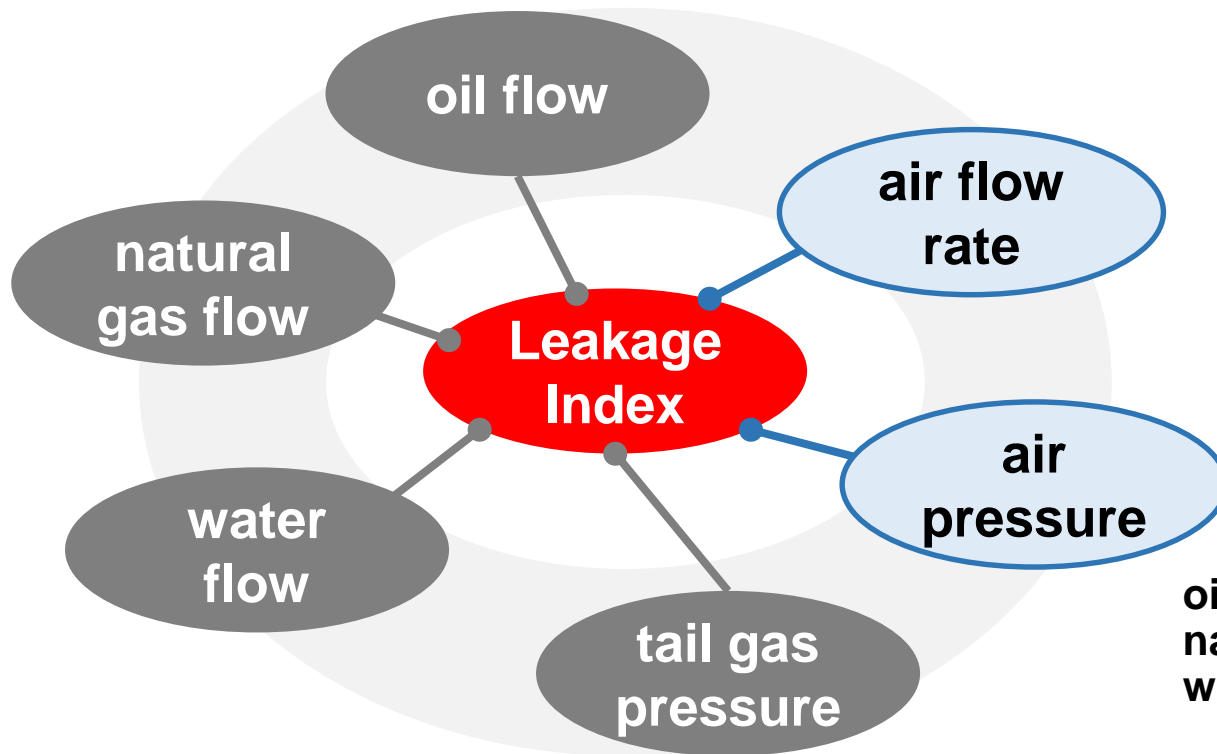
- Dimension:
2,5m x 13m
8.2ft x 43,7ft
- High repair cost
- Production loss
> 10 days
- Damage 2019



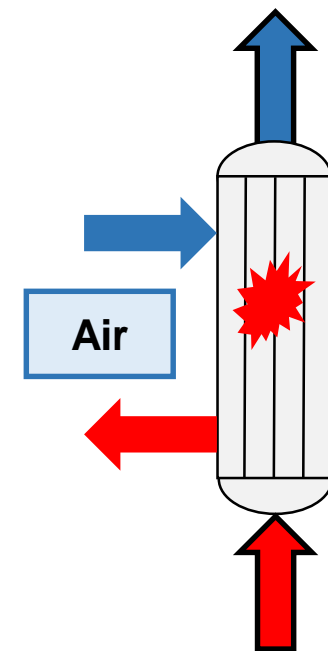
No fixed Leakage Index limit possible



Heat Exchanger: Modeling



oil
natural gas
water



Carbon Black
Tail gas

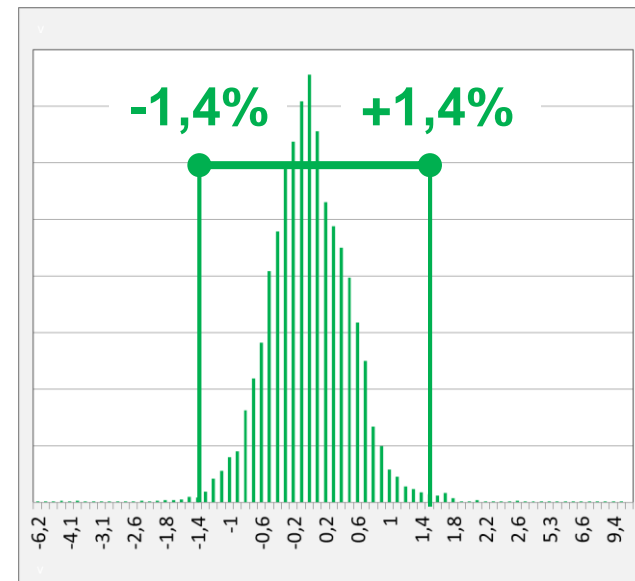
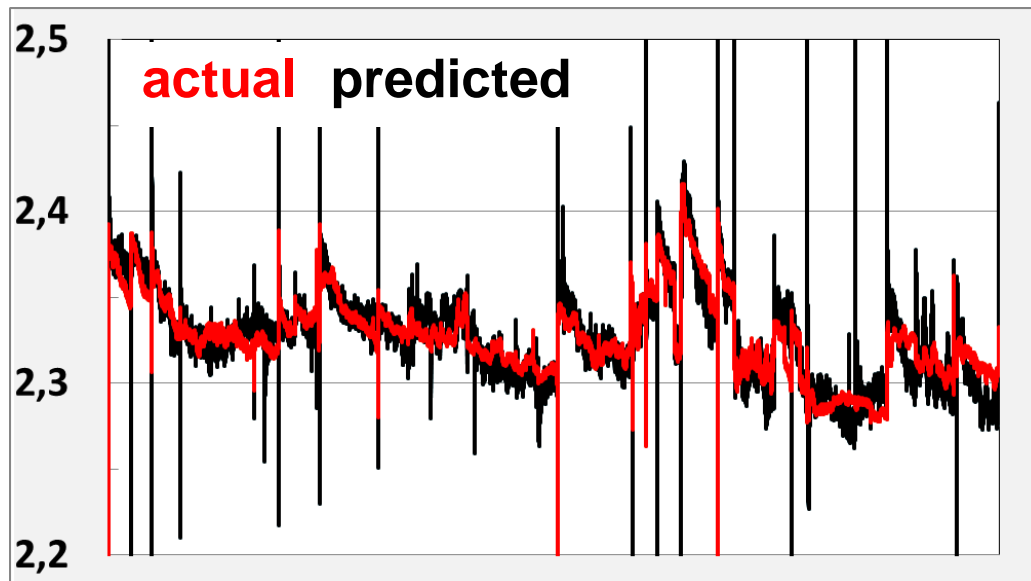
Model training with excellent results

Leakage Index (Heat Exchanger)

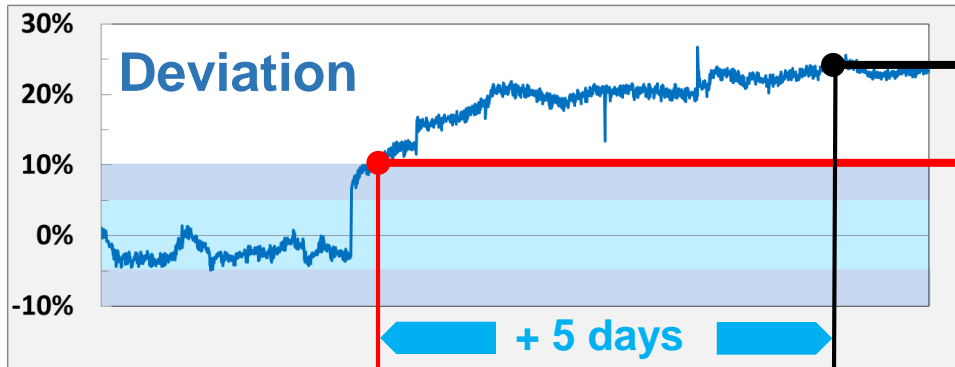
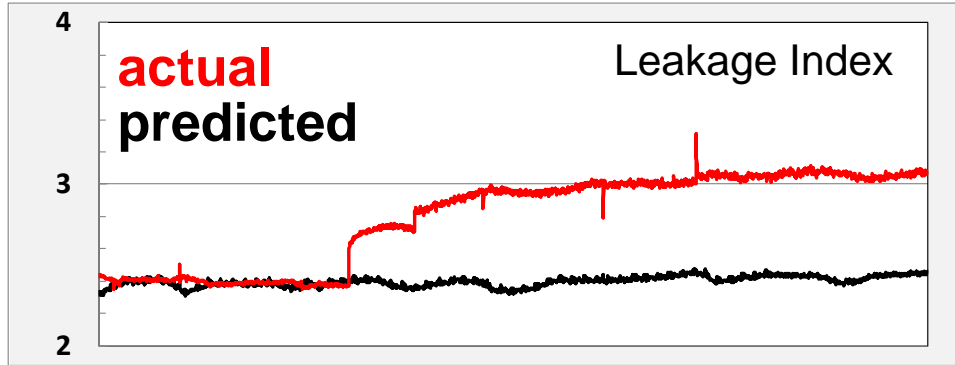
Training data: 1 year data

Deviation (%)

Distribution



Heat Exchanger: Model verification (real damage)



$$\text{Deviation [\%]} = \frac{\text{actual} - \text{predicted}}{\text{actual}}$$

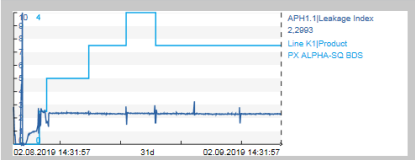
Prediction status:
Alarm: >10% Deviation
Warning: >5%
Good: ≤5%

Connection into AF / PI Vision

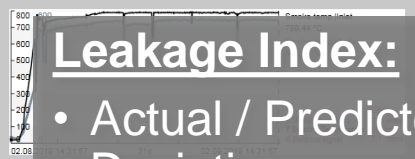
Leakage Index

ORION ENGINEERED CARBONS

Leakage Index (actual)

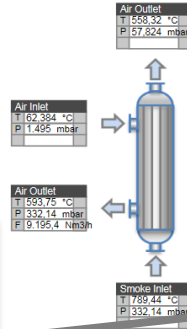


Temperatures for Leakage Index - Smoke

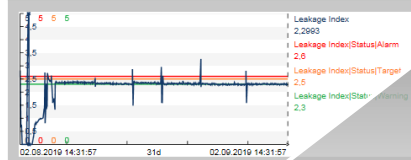


Leakage Index:

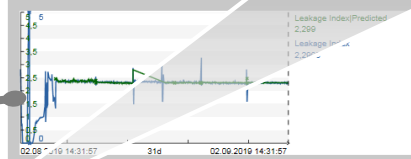
- Actual / Predicted
 - Deviation
- PI AF



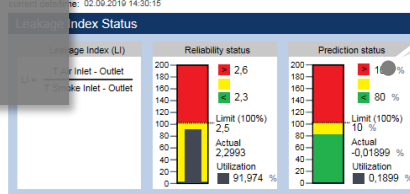
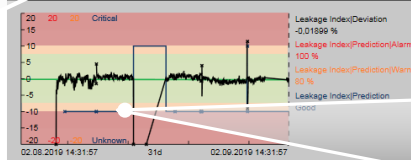
Leakage Index (calculated)



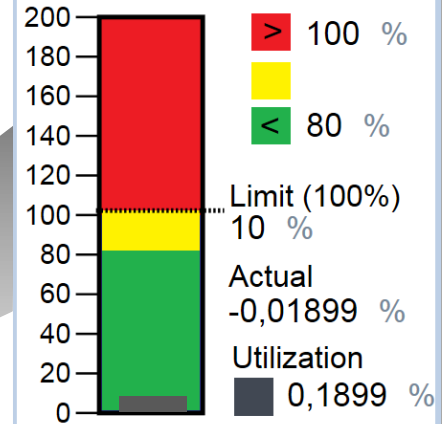
Leakage Index (predicted vs actual)



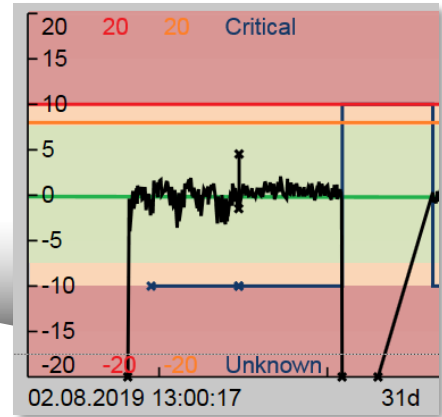
Leakage Index - Deviation (%)



Prediction status




- Prediction status (Deviation / Limit) [%]
- Good/Warning/Alarm



CHALLENGES

- Reactive maintenance
- Unplanned downtime
- Unplanned production loss
- Early detection of equipment failures required

SOLUTION

- ProcDNA application

for advanced data analytics models using historical data of relevant parameters
- Prediction model deployment to real time environment
- Integration of predicted parameters in AF

BENEFITS

- Early warning of potential failures of equipment
- Extra lead time for planning (5 days for heat exchangers leakage, 9 hours for bearing damage)
- Visibility of reliability status: dashboards in PI Vision

Questions?

Please wait for
the **microphone**

State your
name & company



Please remember to...

Complete the Survey!

Navigate to this session in
the mobile app for survey

TO DOWNLOAD
APP, SEARCH
OSISOFT



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TAPADH LEIBH 고맙습니다
BAЯPЛAЛAА MISAOTRA ANAO
DZIĘKUJĘ CI NGIYABONGA TEŞEKKÜR EDERIM GRACIES
OBRIGADO شڪرا SALAMAT
DANKON TANK TAPADH LEAT
DANKIE TERIMA KASIH
KÖSZÖNÖM
СПАСИБО
PAKMET CIZGE
GO RAIBH MAITH AGAT
БЛАГОДАРЯ GRACIAS
ТИ БЛАГОДАРАМ
MAHADSANID
TAK DANKE
RAHMAT
MERCİ
HATUR NUHUN
CẢM ƠN BẠN
WAZVIITA
THANK YOU
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TEŞEKKÜR EDERIM
EΥΧΑΡΙΣΤΩ GRATIAS TIBI
DANK JE
AČIŮ SALAMAT MAHALO IĀ 'OE TAKK SKALDU HA
GRAZZI PAKKA PĒR
PAXMAT CAĞA
FÄLEMINDE
ありがとうございました
SIPAS JI WERE TERIMA KASIH
UA TSAUG RAU KOJ
ТИ БЛАГОДАРАМ
СИПОС
DI OU MÈSI
ĐAKUJEM
MATUR NUWUN