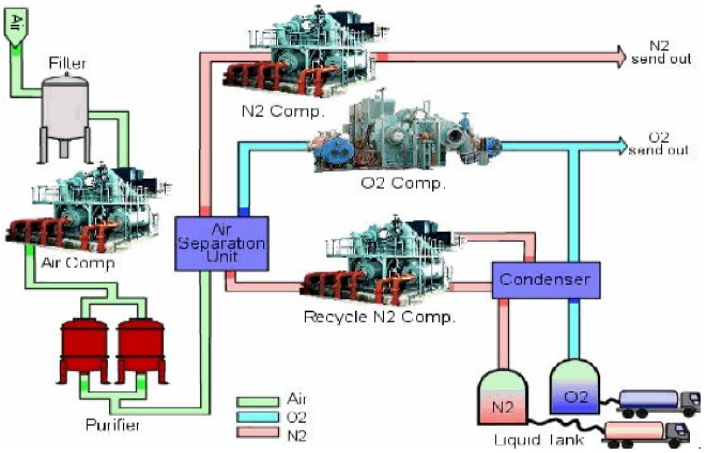
CASE STUDY

APM 360™ Solution for a Top 5 Global Industrial Gases Manufacturer

Industrial gases are used in a wide range of industries, which include oil and gas, petrochemicals, chemicals, power, mining, steelmaking, metals, environmental protection, medicine, pharmaceuticals, biotechnology, food, water, fertilizers, nuclear power, electronics and aerospace. The typical process of manufacturing industrial gases involves high voltage motors driving heavy duty compressors, which feed compressed air into pre-purifiers and air separation units that use fractional distillation to separate air into constituent product gases like nitrogen and oxygen . In this case study, we see how APM 360 is used to predict incipient anomalies of critical assets in the industrial gases segment and provide highly actionable alerts, causes and recommendations, through the use of a hybrid domain-informed AI.



Problem

Rotating equipment like motors and compressors form the core assets of industrial gases segment, hence SymphonyAI Industrial's APM 360 becomes pivotal in predictive and prescriptive analytics of these critical assets, as far as a wider range of fault coverage is concerned to detect incipient anomalies. In this use-case, we will see how critical equipment in such a process can be monitored in order to minimize and avert unplanned downtime and ensure smooth operations. A single process outage in an industrial gases plant can lead to several hours of downtime resulting in production losses to the tune of 0.5MM$.

An example of a commonly used critical asset in industrial gases manufacturing is the process air compressor used to supply compressed air to the air separation unit. In this use-case, the compressor is a large, multi-stage, integrally geared centrifugal compressor, driven by a 20MW synchronous motor, for which an efficient cooling system is an utmost requirement.

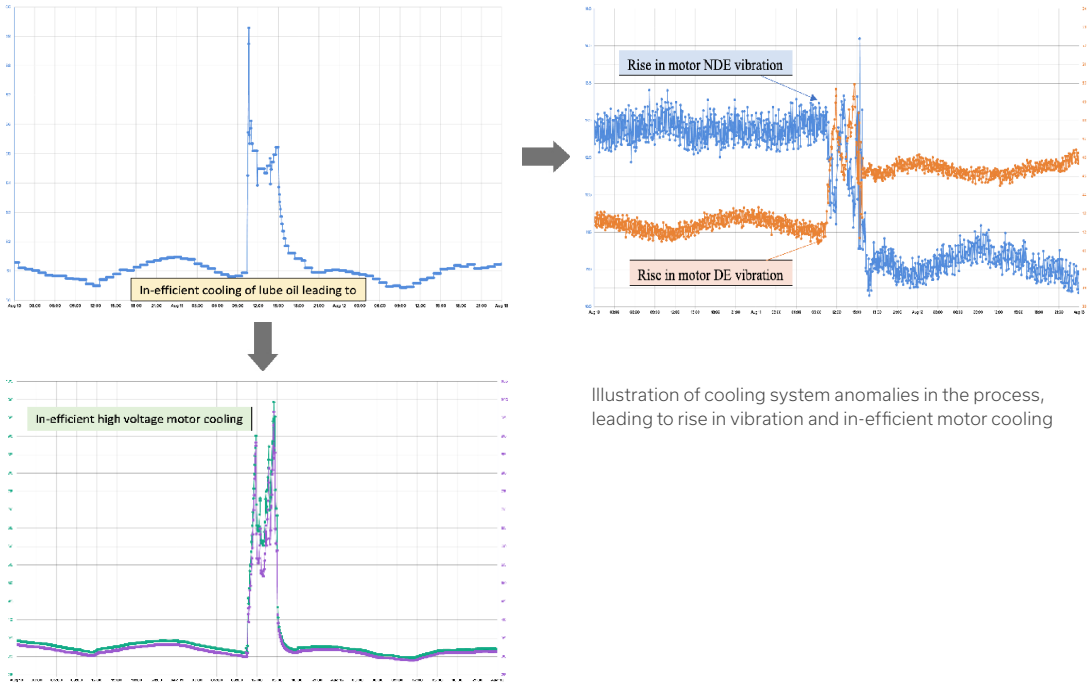


Illustration of cooling system anomalies in the process, leading to rise in vibration and in-efficient motor cooling

The industrial gases plant referenced in this case study was earlier equipped with condition based monitoring, but had no reliable way of predicting impending failure of critical equipment. As a result, mitigation of unplanned shutdowns was not always possible and each shutdown event was having a negative impact on the delivery of industrial gases as well as the health and longevity of the critical equipment.

Sequence of such upsets in the process led to trip of the high voltage motor and the driving compressor, inviting un-planned downtime. Therefore, an early warning system was required that could produce necessary causes and actionable recommendations that would lead to immediate and longer term mitigation of reliability issues.

Solution

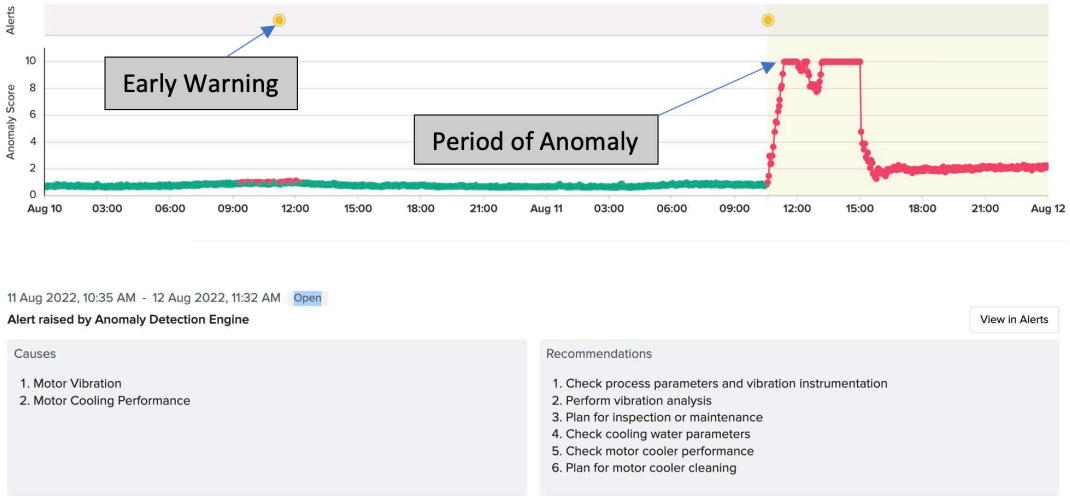
APM 360 was applied at this plant and real-time data from critical equipment was fed into it. APM 360 uses a blend of process data and asset vibration data to detect incipient anomalies and provide insights into them. It leverages IIOT, AI and FMEA that provide real-time anomaly detection with real-time, automated cause analysis and advisories. This ensures greater reliability, uptime, and peak asset performance due to its ability to predict into the future, analyze leading indicators, and provide causes and mitigation steps immediately.

APM 360's anomaly detection system is based on state-of-the-art unsupervised and semi-supervised machine learning algorithms that can identify the key contributing factors for any anomaly detected (e.g. process variables like pressures and temperatures or vibrations). These contributing factors are then fed into a machine reasoning system called the Apparent Cause Engine that can generate one or more apparent causes for the detected anomaly. The machine reasoning engine is based on our proprietary domain-informed FMEA templates that can automatically isolate the underlying cause of an anomaly and give suitable recommendations.

For example, for this particular motor - centrifugal compressor assembly, APM 360 was able to identify an issue with the cooling water system that led to spikes in the lube oil temperature, which in turn changed the viscosity of the lube oil leading to rise in motor bearing temperatures and vibrations, along with in-efficient motor cooling, which could have caused the motor to trip, leading to an un-planned downtime. Such jumps and jerks on a large rotating equipment have adverse long term effects on its health and reliability; however, they may not have been caught by traditional vibration based condition monitoring systems, because vibration analysis in this plant is done on a monthly basis. Whereas, APM 360, with a blend of process data and vibration data, was able to pro-actively flag an alert with apparent causes and recommendations and most importantly, the plant engineers leveraged it to take timely action and avert an un-planned downtime.

Outcomes and Impact:

- Aversion of un-planned downtime with an impact of up to 0.5MM$ per event
- Wide range of fault coverage using asset FMEA templates, with a fault detection accuracy greater than 85%



APM 360 indicating early alerts with apparent causes and recommendation

APM 360 also gives a more wholistic view of asset health and how the asset health is impacted by upstream and downstream components of the process. The relationships between a piece of equipment and the process within which it operates is not always straightforward to explicitly model and therefore data-based modelling methods such as machine learning have seen a lot of success.

For automated data analysis systems to be successful in practice, a strong domain informed machine reasoning system is necessary to interpret results and convert data into actionable insights, causes, and recommendations. All these aspects are built into the APM 360 product.

