Prescriptive maintenance
using Howden Uptime health score in wastewater treatment plants

White paper

Revolving Around You™

Introduction

Abstract

The distinctive feature of prescriptive maintenance is that instead of just predicting impending failure, as predictive maintenance does, it strives to produce outcome-focused recommendations for operations and maintenance. Many industry leaders are considering its potential to become the next level of reliability and maintenance best practice.

Howden has developed a machine-learning analytical model to monitor critical parameters to assess the ability of a machine to perform its intended purpose economically and reliably, through the periodic measurement and analysis of performance indicators and physical indicators. Condition assessments are based upon a comparison of the current indicator values with previous indicator values and predetermined threshold limits.

Cost avoidance can be achieved through the improvement of equipment conditions and the prevention of potential catastrophic failures.

This paper details the utilisation of the health score feature in Howden Uptime, to support predictive maintenance of compressors used in the aeration process of Wastewater Treatment Plants.
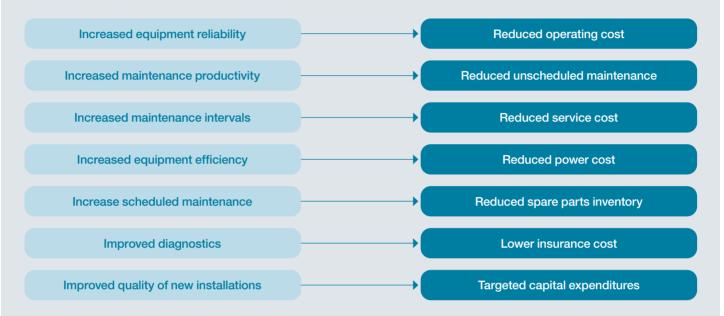
High speed turbo blowers used in wastewater aeration

Wastewater treatment is required to manage effluent from municipal sewage systems and from many industrial processes where liquid organic effluents are produced as a by-product.

The demand for treatment plants is growing quickly in many countries as waste volumes increase with population growth and the focus on environmentally sensitive disposal intensifies.

With aeration accounting for over 60% of power requirements, it is essential to ensure an efficient solution. Rotary blower and turbo compressor technology has been reliably serving wastewater applications for many decades, and with the added benefit of data-driven technology solutions, operational modifications can provide guidance to optimise the performance of rotating equipment.

The need for prescriptive maintenance

An effective prescriptive maintenance program can produce many of the following benefits: [1]

Increased equipment reliability	Reduced operating cost
Increased maintenance productivity	Reduced unscheduled maintenance
Increased maintenance intervals	Reduced service cost
Increased equipment efficiency	Reduced power cost
Increase scheduled maintenance	Reduced spare parts inventory
Improved diagnostics	Lower insurance cost
Improved quality of new installations	Targeted capital expenditures

Typical maintenance cost guidelines and therefore, the potential savings, have been established from maintenance literature:

If a motor is misaligned by 20% of the coupling manufacturer's allowable offset, **then one can expect a 20% reduction in inboard bearing life.** [2]

An unscheduled repair can cost **ten times more** than a scheduled repair. [3]

An increase in vibration from 0.3ips peak to 0.6ips peak can **reduce bearing life by 50%.** [4]

The Howden Uptime health score feature

The Howden Uptime health score feature was developed to achieve the following:

Elimination of root cause of failure in rotating equipment

Early detection of rotating equipment failure

Optimisation of equipment resources

Optimisation of personnel resources through the identification and prioritisation of corrective maintenance needs

Accurate equipment diagnostics

Health value

The health value is driven from the component level and gives the user an insight into current machine performance against the design values.

The health of a component is derived from weighted averages of properties relevant to it, so a bearing vibration might be comprised of X, Y and Z vibrations that have been individually trained and a health value calculated for it.

Time to event

The time to event value is a time prediction on when a part may need to be replaced. This predictive model utilises a machine-learning training model.

The model analytics uses data from previous lifecycles of the same part. This data is analysed by the system and provides a breakdown on anticipated normal operation. The system also learns and understands how the 'goal property' normally behaves. This is used to predict the time until the next event occurs. Like any prediction, it is dependent on many factors and the system monitors, learns and adapts the time to event based on the contributing factors.

Learning techniques

The health score feature uses a neural network learning technique as the operational data isn't always linear due to the variable process loads within wastewater aeration.

Neural networks are a powerful computer modelling method, and during validation it was found to produce the most accurate model results.

Output of the health score feature

Name	Description
Name	The name of the asset
Graph	Average health of lowest health part, each week over the past 7 weeks (including current). In calendar weeks (Monday - Sunday).
Last service	The last part to be replaced on this asset.
Time to event	Number of years / weeks / days until the next event will occur on any part in the asset.
Action	The highest priority action on the asset.
Accuracy	Accuracy of the time to event and health score prediction based on the training data.

The average health for the component with lowest health score, over the past 7 weeks is presented to allow quick identification of deviations.

The health page loads the asset level data - this displays a health trend, last service date, time to event and model accuracy which is based on the lowest health component for that asset. Each asset can also be expanded to see the health score at the component part level.

The alert page displays all alerts which have been triggered based on the time to event and health score, and provides guidance on the intervention required.

The logic which leads to specific recommendations, uses a decision tree which is based on input from the engineers who have designed, commissioned and maintained this type of equipment.
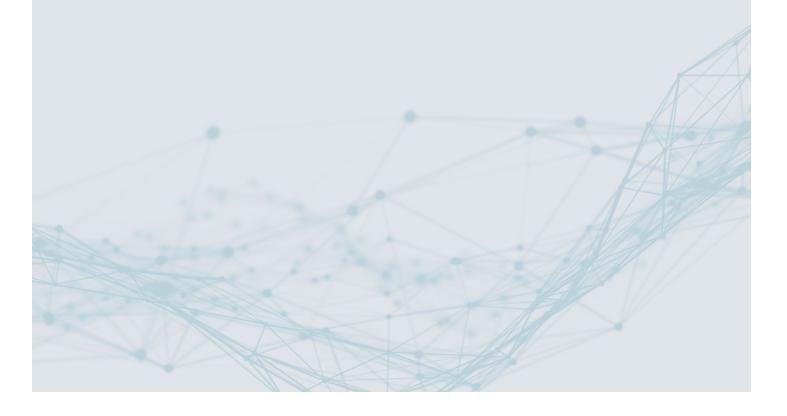
Conclusion

The Howden Uptime health score algorithm is an effective tool to increase the reliability of the wastewater treatment plant's compressor assets and therefore reduce the risk of catastrophic equipment failure and operational permit violations.

The insight and guidance provided by the platform are powerful tools that will allow the prioritisation of corrective maintenance activities, the optimisation of routine maintenance activities, and the prioritisation of capital expenditure.

References

1   Rankin, Kenneth, "Predictive Maintenance Programs: Building a Complete Package",
    Pumps and Systems Magazine, September 1999, pp. 14-27

2   Hines, Wesley J., "Study Shows Shaft Misalignment Reduces Bearing Life",
    Maintenance Technology Magazine, April 1999, pp. 11–17

3   Johnson, Bryan, "Predictive Maintenance - The effect on a Company's Bottom Line Part II

4   Fast Bal I Manual, Revision 3, Published by Computional Systems, Inc., March 1995, Page 6-2

5   Vibrations, Volume 16 No. 2, published by the Vibration Institute, June 2000, pp. 3-5

Author: Graeme Russell
Data Driven Advantage, Howden
e: uptime@howden.com
w: www.howden.cloud/uptime

Revolving Around You™