Case Study

Howden Uptime at Twence waste-to-energy plant

Howden
A Chart Industries Company

With the collaboration of Twence, Howden has been able to develop a **robust, cost-effective condition monitoring system** specifically for cooling fans.

Howden, a Chart Industries Company, has always had a very strong relationship with the Twence waste-to-energy plant situated in Hengelo, Netherlands. Howden has three 34-foot diameter fans running in one of the air-cooled condensers (ACCs) at Twence. These three fans were jointly identified by Howden and Twence as the perfect platforms to test and develop the first Howden Uptime system specifically catered to the challenges associated with large cooling fans.

Air-cooled condenser fan challenges

CC fans are typically installed in arrays of multiple individual fan cells, with some large sites consisting of over 300 fans. These fans draw in ambient air and force them through inclined heat exchanger bundles to condense process steam in a dry-cooled power plant.

During operation, the fans located on the edges of the ACC are subjected to distorted inlet air flow due to wind. In these circumstances, the performance of the fans are degraded and the mechanical loads on the blades, bolts and drive are increased.

It is for this reason that ACC fans are more likely to experience failures than fans installed in other coolin fan applications. The failure of an ACC fan or a degradation in its performance can lead to increased steam turbine back pressure, which may result in the plant experiencing a so-called “trip” and stop producing power.

As a result of the challenges faced by ACC fans, and their importance to the power generation process of a dry-cooled power plant, it was decided by Howden to develop a condition-monitoring system specifically suited to this application.

The challenge

The hardware used in typical condition monitoring systems for an ACC fan consist of a vibration transmitter that measures the overall vibration level at each fan. This vibration level can be recorded at the plant DCS, but is often only used to stop the fan in the event that the vibration levels exceed a maximum allowable level.

This maximum vibration level is commonly set according to the limits provided in the ISO 14694 or ISO 10816-3 standards, but may also be set during commissioning of the fans based on the actual vibration levels at the time.

A major shortcoming, inherent to this type of vibration transmitter, is the fact that typically only an overall vibration level is measured. This means that an average (rms) vibration level is calculated over the entire frequency measurement range of the transmitter.

As a result, it is not possible to determine which frequencies, contained in the vibration spectrum, are causing elevated vibration levels. Windy conditions may result in high vibration velocit levels at low frequencies, which are not harmful to the fan drive.

Conversely, the failure of a complete fan blade will cause increased vibration levels at such a low frequency that the transmitter may not stop the fan.

Furthermore, individual fan performance is typically not monitored by an ACC operator. Instead, plant-level metrics such as the turbine back pressure is used to determine whether a group of fans is performing as required or not. Improved knowledge of fan performance, relative to other fans in the ACC, may lead to the implementation of energy saving actions, such as the reduction of blade angles or fan speeds at certain fans.

The solution

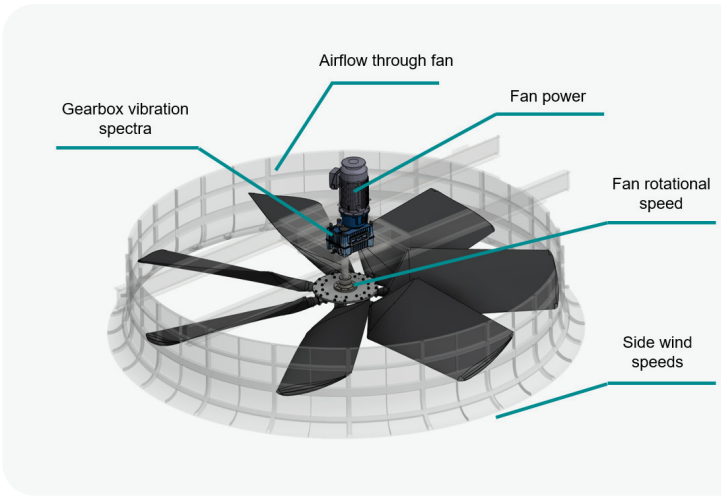
The cooling fan specialists at Howden set out to develop a cost-effective condition monitoring system capable of overcoming the shortcomings of standard vibration-based condition-monitoring solutions.

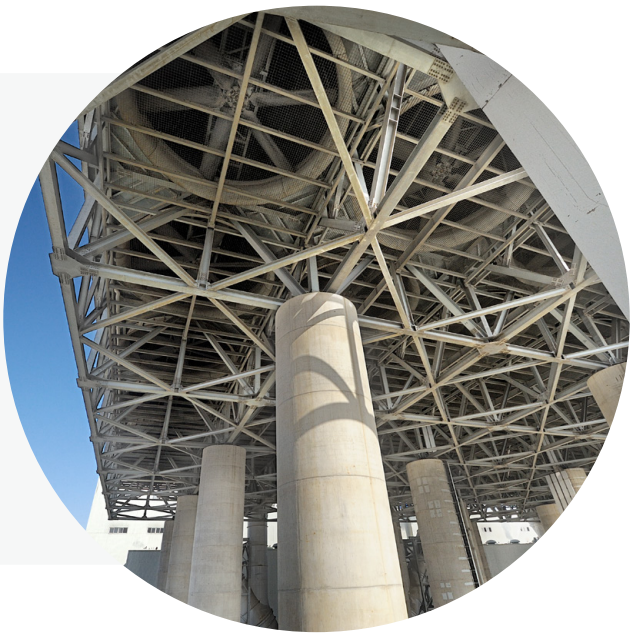
The solution that was developed consisted of vibration level and spectrum measurements at the fan gearbox that were supported by the measurement of the wind conditions at the ACC.

In addition, the air flow through each fan was also measured in conjunction with the fan speed and power. These measurements would then be recorded and securely transmitted to the Howden Uptime platform for analysis.

Howden Uptime is a unique digital solution for equipment performance optimization. Combining over 160 years of OEM expertise with the most advanced industrial IoT architecture in the world, Howden Uptime can support maintenance strategies, reduce unplanned downtime and enable safe and reliable operations.

Using Howden Uptime, the root cause of elevated vibration levels can be identified remotely, before an unplanned maintenance outage is necessary. Additionally, the performance of each of the three fans could be tracked relative to one another to advise more energy efficient operation of the fans and cleaning of the heat exchangers.





The results

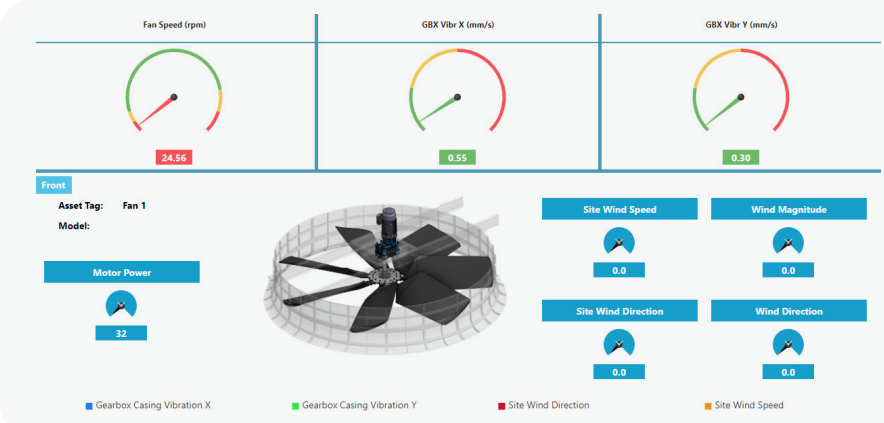
The Howden Uptime system was installed at Twence in 2022. The connection of the assets to the Howden Uptime platform was completed shortly after installation. Since this time, the data received from site has been continuously monitored and analysed by Howden. **Data analysis yielded the following potential benefits to the customer and the development of Howden Uptime for cooling fans:**

As expected, correlations were found between the overall vibration levels of the fan and the prevailing wind conditions. These correlations are now used to define vibration limits that are based on the wind speed and direction. In this way, the alarm levels will be less likely to be exceeded during short periods of high winds while still maintaining a high level of sensitivity.

The relative performance of each fan was used to identify an optimal operating region with respect to air flow and power consumption. When a fan operates outside of this region for an extended period of time it would typically mean that the heat exchangers need cleaning or that the blade angle of the fans have changed unexpectedly due to a loss in bolt preload, for example.

It was found that the optimal operating regions differ for each of the three fans and that there are potential energy savings to be realised in operating these fans differently. When installed in an ACC, each individual fan operates at a slightly different duty point due to deviations in their inlet conditions as a result of wind or the working of adjacent fan cells. As such, there is an opportunity to monitor the performance and alter the fan speed or blade angle of individual fans. As an example, at Twence the fan static efficiency could potentially be increased by approximately 2% through changes to the blade angles and fan speeds.

Specific frequencies have been identified that are related to the condition of the gears and bearings of the gearbox. Even though these components are not delivered by Howden, the vibration levels at the gearbox-related frequencies are tracked over time within Howden Uptime to provide the customer with an indication of the gearbox condition. When these frequencies exceed certain thresholds, Howden can propose the planning of service activities.



With the collaboration of Twence, Howden has been able to develop a robust condition monitoring system specific for cooling fans installed at ACCs. **This system is scalable, cost-effective and able to deliver multiple benefits with respect to maintenance planning and energy savings.**

For further information get in touch with our team today:

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