Vibration Monitoring of Cooling Towers

Applications

Cooling tower fans have uses in multiple industries. They can act as heat exchangers for chiller systems in heating, ventilation, and air conditioning (HVAC) applications, or they can be used in heat exchange processes in other industries such as power generation, manufacturing, and in other processing plants.

Types

There are two types of cooling tower fans. The first type of cooling tower fan is called a gearbox driven fan. This type of fan has the motor mounted to the side of the fan’s cell and drives the fan using a shaft. The other type of cooling tower fan is called a belt driven fan. This type of cooling tower fan has mounted inside the fan’s cell meaning that both components are in the air flow.

Causes of Failure

Common causes of failure in cooling tower components can often be linked to either the misalignment or imbalance of a component.

Failures

Data collected during a case study at a Bristol-Myers Squibb plant found that the most common failures in cooling tower components were related to the motor (60 percent of the time), the gearbox (30 percent of the time), the fan (two percent of the time), with other tower components making up for the rest of the failures.¹

More specifically, in motors, the failures that can occur can be caused by motor imbalance, rotor bar defects, output shaft alignment, bearing defects, and motors that are not properly bolted
In gearboxes the failures that can occur can be the result of stresses that the gearbox experiences from being in the airflow of the cooling tower, misalignment of the gear with the motor, added stress to the gear teeth, or bearing failures.

As shown by the Bristol-Myers Squibb plant study, fan failures are relatively uncommon. However, when they do occur fan failures can be catastrophic in nature. If left unmonitored, fan blades can detach, or break (see Figure 1), and damage the surrounding cooling tower cell and any surrounding components. Fan failures can be the result of inbalanced fan blades or changes or errors in blade pitch.

What Should Be Measured

On gearbox driven fans it is important to collect vibration data on the motor and on the gearbox.

On a belt driven cooling tower fan it is important to collect vibration data on the fan inboard pillow block bearing, on the motor inboard bearing, and intermediary bearings on the fan shaft.

Analysis

When analyzing vibration data from a cooling tower, it is important to monitor fan speed, motor speed, bearing frequencies, shaft turning speed, blade pass frequency (fan speed multiplied by the number of blades), and gear mesh frequency (number of teeth on a gear multiplied by the rotational frequency of the gear).

In general, most cooling tower fans run at a speed somewhere between 90 and 300 revolutions per minute (rpm) while motors for cooling towers generally run at speeds around 1,800 rpm.

Savings

Since cooling towers are an integral part of many industries it is important that they be monitored regularly. Catastrophic failure of a cooling tower can result in the failure of other equipment, safety hazards, lowered production (especially in industrial settings), expensive repairs, and health issues (especially in HVAC settings, where in certain cases improperly installed cooling tower fans have caused vertigo in people inside a building when the cooling tower fan started to resonate to the natural frequency of steel).

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