Machinery Diagnostics Institute

Case Study: Gear Mesh Faults

Introduction

Gear mesh faults are a common problem in mechanical systems that involve gears. A gear is a rotating machine part with teeth that mesh with other gears to transmit torque and power between different parts of the machine. When the teeth of the gears do not mesh properly, it can cause vibrations, noise, and wear, leading to premature failure of the gears and the entire system. Gear mesh faults can be caused by a variety of factors, including design, manufacturing, and operation.

There are several types of gear mesh faults, including:

- *Wear:* Over time, the teeth of the gears can wear down due to repeated contact with each other. This can cause a decrease in performance and increase the risk of further damage.
- *Pitting*: Occurs when small cracks or holes develop on the surface of the gear teeth due to repeated stresses or impacts.
- *Cracking*: Can occur in gears due to excessive stresses or impacts, and can lead to catastrophic failure if not detected and repaired.
- *Misalignment*: Occurs when the gears are not properly aligned with each other, which can cause uneven wear and damage to the teeth.
- *Scoring*: Occurs when the teeth of the gears become scratched or scored due to foreign objects or debris in the system.

Analysis

MDI was commissioned to perform routine data analysis at a Cement Plant. A gear mesh fault was found on a gearbox.

MDI utilized the following hardware for this analysis:

- CTC's AC246 Mini Size, Side Exit, 100 mV/g Accelerometer
- CTC's MH128-1A Magnetic Mounting Base
- CTC's CB108-J2C-006-C555-SF Emerson/CS Compatible Cable and Connectors Assembly
- CSI 2130 Data Collector

Utilizing a cable with a breakaway safety feature for portable data collection (as shown here) is extremely important for analyst safety while collecting data on large operating machinery

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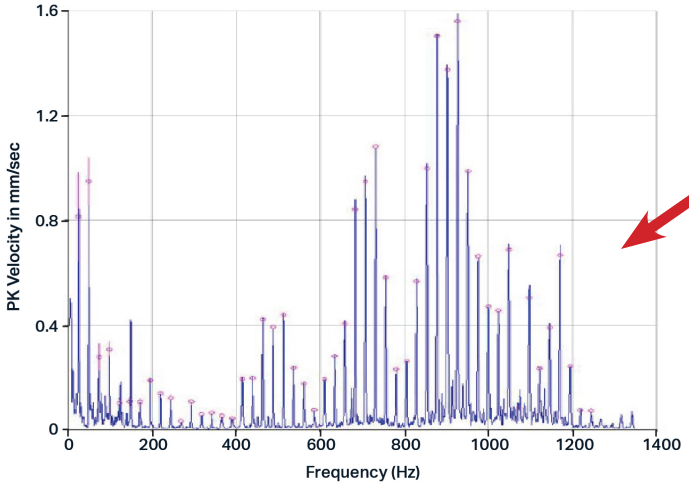
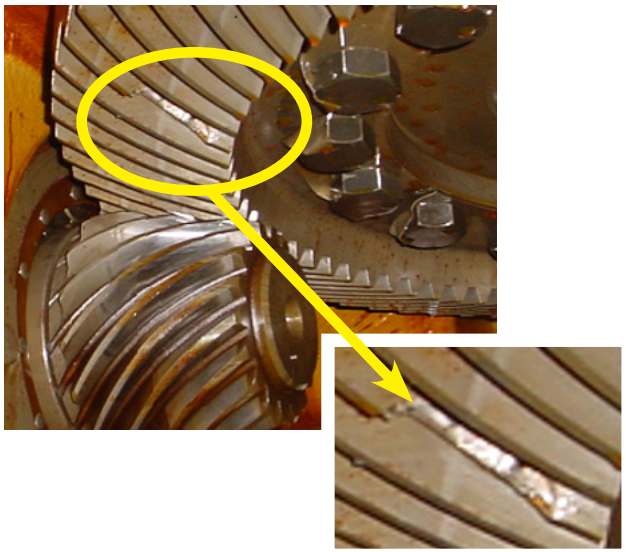
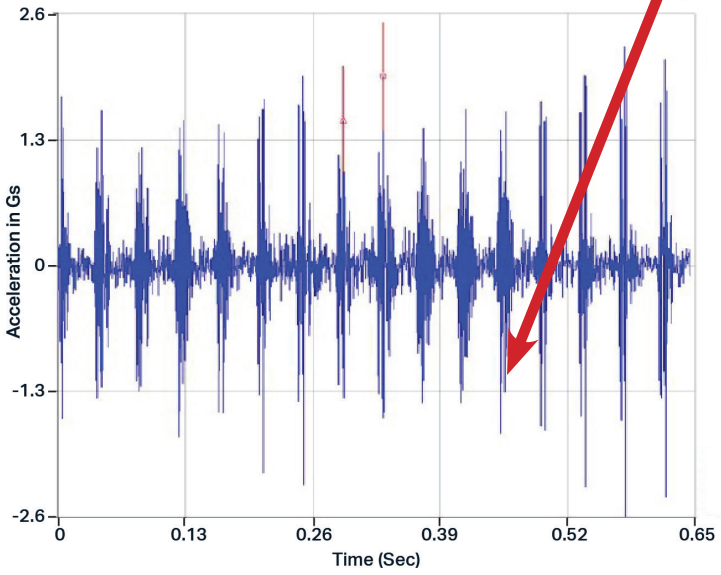
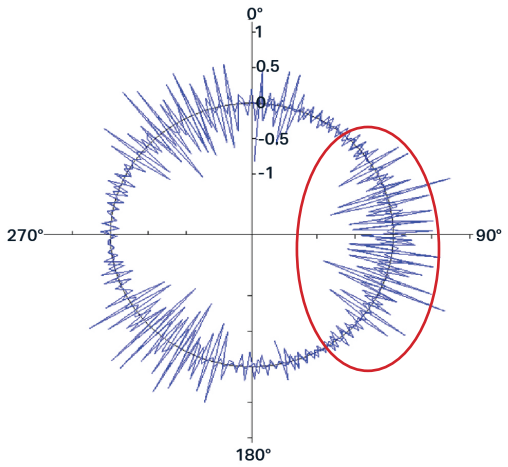
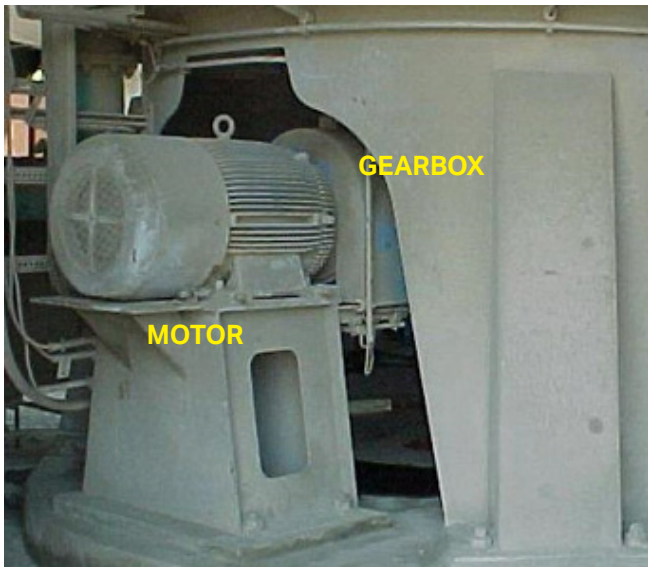


Gearbox bearing spectrum showing elevated vibration at the running speed with harmonics in addition to high amplitude impacting vibration at the time wave form at the running speed indicative of cracked or broken gear teeth









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Conclusion

Through routine data collection, MDI was able to see that there was a clear gear mesh fault, which ended up being a chipped tooth. As a result, the recommendation was to replace the gear, prior to failure.

Selecting the correct accelerometer for gearbox measurements is important. MDI selected the AC246 because of its premium design that allows for an extremely wide frequency response range for a side exit accelerometer. This side exit sensor features an integral stud, which allows the sensing element to be centered within the case to maximize high frequency response (unlike other side exit sensor designs which feature a captive bolt that offsets the sensing element). This design allows the sensor to achieve a broad frequency response range of 0.6 to 15 kHz ±3 dB, enabling it to detect a wide range of faults.

Related CTC Products

In addition to the CTC products used by MDI, CTC also offers a variety of vibration analysis hardware solutions that are ideal for use in applications like those explored in this case study. For some gearboxes, utilizing a 500 mV/g accelerometer may be appropriate. Slow-speed gearboxes are typically used in applications where the output speed of the gearbox is relatively low. These gearboxes are designed to provide high torque at low speeds. 500 mV/g accelerometers are specifically designed to detect low speed, low amplitude vibration beginning at 0.1 Hz. For slow-speed gearboxes, CTC recommends:

AC133 and AC134 Standard Size, Top and Side Exit, 500 mV/g Accelerometers mounted on MH214-3A multipurpose magnetic mounting base

CB104-K2C-006-C555-SF Cable and Connector Assembly