

XYZ Corporation
Anywhere, USA

Prepared for:
Inspection date:

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XYZ CORPORATION

Anywhere, USA

June 01, 2000

Technician: G. Hutto

This report contains results of vibration analysis performed on **the Kiln Drive, East and West motors and gearboxes. Data was collected on m/d/y.**

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General

Work Order #:
Date Performed: m/d/y
Plant Contact:
Location:
Technician: G. Hutto

Request

It was requested that MDI collect vibration data on the #1 Kiln for the purpose of suggesting why one of the two drives on this gearbox consistently has higher vibration values than the other. The drive, which has the higher vibration values, is the East drive. The East drive also has higher audible noise than the West drive. Any attempt to increase the speed of this Kiln has produced excessively high vibration values on the East drive.

Methods

The first step was to review the routine route data collected by plant personnel and the history of the machine. The route data collected by the in-house team contained samples that indicated the higher vibration that matched the description of the problem as it was related to MDI.

In the second step, MDI created a database in the SKF software to prepare for collecting test data. This plant uses the CSI data collection equipment. Plant personnel would also collect data using the CSI equipment.

The approach was as follows:

1. Collect fresh data with the Kiln loaded and at normal speed. Both MDI and plant personnel would collect data each using their own equipment.
2. Analyze the data to identify all known frequencies in the machine, including all shaft speeds and gear-meshing frequencies.
3. Compare the data from both sets of data collection equipment (SKF and CSI).
4. Use this data to determine the frequencies that were the source of the “high” vibration.
5. Attempt to identify the frequency of the audible noise.
6. Speed the Kiln up and take a second set of data with identical parameters as the first set.
7. Compare/contrast the data.

Findings

1. The data did not compare exactly between the CSI equipment and the SKF equipment. This should not have been the case. While the data devices are made by different manufacturers, the

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technology in the data collectors is virtually identical and the set-ups used should have compared more favorably. The difference observed was that the amplitudes of the CSI data were consistently lower than the SKF and the detail of the frequencies were considerably better with the SKF equipment. The suspicion was that the transducer on the CSI box was not functioning properly. No tests were performed at the time to confirm this.

2. The known gear mesh frequencies and shaft frequencies were identified including motor speed, clutch speed and pinion to girth (bull) gear meshing frequency.
3. On the East drive, the frequency that was most affected after the speed change was the gear meshing frequency of the second intermediate shaft. This frequency went up quite disproportionate to the speed. Under most circumstances, the vibratory energy increase due to a speed change should be somewhat proportional to the speed change.

On the West drive, the energy increases, including the second intermediate gear meshing frequency were more proportional to the speed.

Here we have identified the question that must be answered; What is the cause of the disproportionate energy on the East drive at second intermediate gear meshing frequency?

4. There was some suggestion by plant engineering that the pinion gear driving the Kiln might some how be the source of the unacceptable vibration and that it might be manifesting itself in the drive gearbox. While this possibility was not completely eliminated, there was no evidence of any increase in energy at or coming from the pinion.
5. The vibration data collected on the East drive at the second intermediate gear shaft suggests a severe backlash condition.
6. A possible outer race bearing defect was detected in the West drive gearbox on the output shaft.

Recommendations

1. Exchange the transducer on the CSI data collector for a new or tested one. A simple on-site test can be performed by taking data on the exact same point on the same machine using two or more transducers. If the data varies greatly, perhaps a new or tested transducer is in order.
2. The possible bearing defect on the West drive should be followed and verified. If the data continues to trend up at the suspect frequency, the bearing should be replaced.
3. *Addressing the reason this project was undertaken... the question: What is the cause of the disproportionate energy on the East drive at second intermediate gear meshing frequency?*

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The data indicates a severe backlash in the gear set between the 1st and 2nd intermediate gear shafts. There are several possible causes.

- a. The backlash was set improperly

This is unlikely. At one point another gearbox had been placed in service on this drive and the vibration was similar. It is not often the case where two entirely different gearboxes would have such a backlash problem. In addition, the West drive gearbox is identical. Why, then, does it not have the problem?

- b. The West drive is “overdriving” the system forcing the gears in the East drive to be unloaded during much of the Kiln rotation. This type of backlash is actually more commonly referred to as slop.

This is more likely the cause. The West and East drive speeds are controlled by eddy current slip frequencies. It is suspected that in some way, the West drive is being allowed to carry more of the load than the East drive.

This possibility has been considered in the past; a test was ran in an attempt to prove this case. The test involved reducing/increasing the current on one or both of the eddy current clutches. No noticeable improvement was detected during this test.

Perhaps the test was not sufficient to more effectively load the East drive. Using a stroboscope, it was clear when watching the East drive input shaft at the gearbox that the input speed was “pulsing.” This is exactly what we might expect when backlash due to loading and unloading is present. A test that conclusively proves that the East gearbox is loaded more than the West is recommended.

One item to consider is that the speed/load should not be determined by the eddy current draw, but rather by the actual input shaft at the gearbox speed. Placing tachometers (if not already present) at the input of each gearbox might be helpful. Also, there must be some speed feedback mechanism on these motors and eddy current clutches. Maybe these could be used.

More testing should be done to shift the load to the East drive. MDI will gladly participate in this effort if requested to do so.

Conclusion

We believe you were on the right track when attempting to load the East drive more completely. More testing is recommended in this area. An unexpected bearing defect frequency was detected on the West drive output shaft. That bearing should be monitored for change and replaced if the data warrants. The transducer on the CSI box should be verified.