

Application: Bio-fuel Premature bearing failure traced to structural resonance.

Problem

A bio-fuel producer takes in waste oil products and turns them into renewable diesel. Shortly after a pump that is used to transfer hot hydrocarbons was repaired, it experienced bearing failure. Because there was no clear operational reason as to why this might have happened, further investigation was warranted.

Finding the root cause

Bearing failure analysis indicated that the balls showed clear signs of skidding. Cage pocket wear was also excessive for the run time, which is consistent with poor ball control. Skidding is due to a lack of sufficient loading, which can be aggravated by certain flow regimes. Replacement with preloaded bearings can solve this problem, but it was decided to investigate the underlying cause.



Many circular scars all over the surface of the ball indicated skidding.

To gather more information, an i-ALERT® health condition monitor was attached to the pump. These tiny sensors measure tri-axial vibration (with spectra), tri-axial kurtosis, temperature and run-time hours as an uninterrupted stream of time-stamped data. It quickly revealed the presence of a structural resonance at 2x the running speed of the pump in the radial direction.

Solution

In order to rectify this situation, either the input energy exciting the resonance needed to change, or the structure needed to be modified to change its natural frequency. After finite element modeling was performed to investigate possible changes to the structure, it was determined that changing the pump's running speed was the best course of action.

Speed modification required impeller changes, a VFD drive and an engineering review of performance and power changes. Because of the level of intelligent control that it provides, an ITT PumpSmart® VFD was incorporated into the system.

The pump's running speed has now been moved far enough away from the structure's natural frequency so as to no longer excite it. If uncorrected, bearing failures would no doubt have continued to occur. As an extra precaution, preloaded bearings were used in the replacement.

In the end, it was the data gathered from the iALERT and the running speed change enabled by PumpSmart which resulted in a pump that is now functioning with far greater reliability—and consequently, much lower maintenance costs.