Sound & Vibration Measurements – ME 459/659 Spring 2019

invites ME students and faculty to a unique presentation on practicing engineer

Thursday, February 14, 5:30-6:30 pm JCAIN 202

Actual Case Studies of Vibration Measurement in the Field

by

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Abstract

CASE 1: HIGH SYNCHRONOUS VIBRATION ON OVERHUNG-ROTOR COMPRESSOR

This case study presents the investigation performed on an overhung rotor which was under high synchronous vibration at the coupling end after being overhauled, preventing the user to operate at full load. The study includes field vibration data and rotordynamics analyses. The one-stage overhung rotor was fully repaired, including bearings & seals' replacement, and rotor balancing. During the initial runs with no load, the rotor showed acceptable vibration amplitude at both ends; however after being loaded, the vibration on the drive end increased at constant speed and proportionally to the load.

A detailed spectrum & orbit analysis from the data recorded on the field showed a synchronous 1X vibration at the coupling end, which was rising up from 1.0 mil Peak-Peak to 3.5 mils Peak-Peak while the unit was loading up at constant speed of 7400 RPM. On the non-drive end, the vibration remained below 1.0 mil Peak-Peak, even after loading the unit.

Based on the severity of the vibration, it was decided to perform a rotordynamics analysis to recognize the possible causes of the observed behavior. The actual mass properties and bearing characteristics were introduced in a finite element based dynamics rotor-bearing system program which could calculate the response and mode shapes.

The output results from the rotordynamics software confirmed that having an actual coupling-end-bearing diametral clearance of 0.4 mils bigger than the maximum recommended, created a mode shape with orbits larger at the coupling end than the ones at the impeller end. The calculated response plot was very similar to the field response, enlightening the root cause as excessive bearing clearance.

This is an interesting case which shows how minor deviations on bearing clearances can makes big differences on the rotor response, and it also illustrates how powerful can be the rotordynamics analysis in helping to identify these deviations.

Download complete case study at 44th Turbomachinery Symposium in Houston in 2015 (CS09)

CASE 2: SUBSYNCHRONOUS VIBRATION ON CENTRIFUGAL COMPRESSOR

This Case Study presents the investigation made in a charge gas machine that was operating under conditions of sub-synchronous vibration that could severely affect its reliability. The study reviews the actual vibration signatures and the compressor performance curves, identifying the source of the instability as stall.

A detailed spectrum analysis from proximity probes showed the presence of a significant sub-synchronous component, making the overall vibration to fluctuate from a normal level to an alarm level. Additional vibration analysis using accelerometers on the bearings casing showed high amplitude-high order components which correspond to the impeller-vane pass frequencies.

Further review of the compressor performance curve confirmed that in fact the compressor likely was approaching the surge zone, and thus the observed instability was associated to a stall phenomenon. After implementing the revised minimum flow, the sub-synchronous component vanished, and the overall vibration returned to normal level.

The case study illustrates a simple methodology to investigate an instability condition by using common tools of vibration analysis and without removing the unit from service; thus resulting in a tremendous benefit for the user and improving the machine reliability.

Presenter Bio

MANUEL MARIN joined LyondellBasell Petrochemical Industries in Channelview, Texas in 2013 as a Sr. Reliability Engineer and previously, he worked for Dresser-Rand as a Sr. Rotordynamics Engineer, and for PDVSA as Rotating Equipment Engineer. He has over 29 years' experience, leading several root cause failure analyses and troubleshooting turbomachinery. Mr. Marin is a graduate from Polytechnic University in Venezuela obtaining a B.Sc. degree in Mechanical Engineering and received a MSc degree in Mechanical Engineering from Texas A&M University (Aggie class of 1996). He is a Certified Vibration Analyst Category III and a member of the Vibration Institute.

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