
PRACTICAL MACHINERY VIBRATION ANALYSIS AND PREDICTIVE MAINTENANCE



YOU WILL LEARN HOW TO:

- Understand the basics of vibration measurement
- Apply vibration analysis for different machinery faults
- Apply specific techniques for pumps, compressors, engines, turbines and motors
- Diagnose machinery related problems with vibration analysis techniques

WHO SHOULD ATTEND:

- Instrumentation and Control Engineers
- Maintenance Engineers
- Mechanical Engineers and Technicians
- Control Technicians
- Electrical Engineers
- Electricians
- Maintenance Engineers and Technicians
- Process Engineers
- Consulting Engineers
- Automation Engineers

The Workshop

This practical workshop provides a detailed examination of the detection, location and diagnosis of faults in rotating and reciprocating machinery using vibration analysis. The basics and underlying physics of vibration signals are first examined. The acquisition and processing of signals is reviewed followed by a discussion of machinery fault diagnosis using vibration analysis, and rectifying the identified faults. The workshop is concluded by a review of the other techniques of predictive maintenance such as oil and particle analysis, ultrasound and infrared thermography. The latest approaches and equipment used together with current research techniques in vibration analysis are also highlighted in the workshop.

Pre-requisites

This is not an advanced workshop but one aimed at the fundamentals. A basic knowledge of electrical and mechanical concepts would be useful.

Workshop Objectives

When you have completed this workshop you will be able to:

- Understand the basics of vibration measurement
- Demonstrate the basics of signal analysis
- Understand measurement and the characteristics of vibration signals
- Use data acquisition equipment for vibration signals
- Apply vibration analysis for different machinery faults
- Apply specific techniques for pumps, compressors, engines, turbines and motors
- Apply vibration based fault detection and diagnostic techniques
- Diagnose machinery related problems with vibration analysis techniques
- Apply advanced signal processing techniques and tools to vibration analysis
- Detect, locate and diagnose faults in rotating and reciprocating machinery using vibration analysis techniques
- Identify conditions of resonance and be able to rectify these problems
- Apply basic allied predictive techniques such as oil analysis, thermography, ultrasonics and performance evaluation

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

INTRODUCTION

- Evolution of maintenance in process plants
- Classification of plant machinery
- Maintenance strategies as adopted to each class of machinery
- Identification of critical machinery and adoption of CBM
- Principles of predictive maintenance, its utilisation in detection and diagnosis
- Various techniques under predictive maintenance
- Vibration analysis as one of the key Techniques

VIBRATION BASICS

- Spring mass system - mass, stiffness, damping
- Wave fundamentals - concepts of amplitude, frequency, fundamental frequency, harmonics, phase, waveforms (sinusoidal, complex) - concepts of peak, peak-peak, rms
- Vibration parameters - displacement, velocity, acceleration
- Choice of vibration parameters
- Using vibration theory for machinery fault detection
- Limits and standards of vibration

DATA ACQUISITION SYSTEMS AND TECHNIQUES

- Vibration transducers and their mountings
- Data acquisition equipment - hand held meters, data collectors (single, dual channel), online monitoring
- Equipment setup and data collection
- Basic steps in data acquisition, overlapping, windows

BASICS OF SIGNAL ANALYSIS

- Time waveform analysis
- Fast fourier transform analysis
- Phase measurement
- Enveloping and demodulation
- Orbits
- Advanced signal analysis
 - Triggered data capture
 - Synchronous time averaging
 - Peak holding averaging
 - Coastdown analysis (bode/Nyquist)
 - Enveloped spectras - gSE, peakvue, SEE
 - Modal shape analysis
 - Cross channel analysis - coherence FRF, TRF
 - Cepstrum
 - Torsional vibration

VIBRATION ANALYSIS FOR DIFFERENT MACHINERY FAULTS

- Unbalanced
- Misalignment, looseness, distortion
- Bad bearings, journal
- Gears, couplings
- Critical
- Resonance
- Electrical
- Miscellaneous

MACHINERY SPECIFIC VIBRATION ANALYSIS

- Pumps
- Compressors
- Engines
- Turbines
- Motors

VIBRATION MONITORING AND ANALYSIS - TURBOMACHINERY

- Importance of shaft vibration - usage of eddy current probes
- Installation of probes on a turbomachinery train
- Brief description of the turbomachinery vibration setup
- Spectrum plot, cascade plot, waterfall plot, bode plot, polar plot, shaft centreline plot, wave form plot, orbit plot, shaft deflection plot, data trending plot, axial movement plot, full spectrum
- Typical problems associated with turbomachinery - oil whirl/whip, structural resonance, vane blade passing, misalignment, rotor rubbing and shaft cracking

RESONANCE - IDENTIFICATION AND RECTIFICATION

APPLICATIONS OF VIBRATION

ANALYSIS - BALANCING OTHER PREDICTIVE TECHNIQUES

- Oil particle and wear debris analysis
- Thermography
- Ultrasonics
- Performance evaluation