



Machine Failure Analysis & Troubleshooting Techniques

Training Program



Introduction:

This course provides the appropriate mix of fundamentals, methodologies, best industry practices, and practical tools to enhance the competencies and improve the performance of operation and maintenance technical professionals individually and collectively with the objective of adding value to the organization and improving the plant safety and reliability. Mechanical Equipments constitute the major portion of plant assets and their integrity and reliability are essential for plant availability and performance. Many process equipment and piping systems are subjected to hazardous service conditions and damage mechanisms which, if not adequately monitored and assessed, could result in major failures with consequential significant injuries and business losses.

It is essential to inspect them to detect any damage, characterize it, and assess its impact on the equipment integrity. With so many pieces of equipment and extensive piping systems and networks, it is obviously impossible to inspect totally every piece of equipment or piping in a plant. Therefore, an approach based on criticality, i.e. risk-based, taking into consideration the damage mechanisms and failure risk must be taken.

Course objectives

By the end of this course delegates will be able to:

- Understand of Machine Failure Analysis and Troubleshooting techniques
- Understanding of a range of Planned & Predictive Maintenance Technologies
- Know of the potential contribution of each these technologies to maintenance efficiency.

- To provide the participants with the knowledge and failure analysis skills they need to conduct damage and failure analysis so as to prevent similar failures from happening.
- To provide the participants with a clear understanding of the degradation mechanisms that process equipment could be subjected to over their operating life, how to identify them, predict and determine their impact, and what appropriate measures can be taken to prevent and control the resultant damage.
- To enhance the knowledge and skills of the participants in hazard identification and analysis; and in risk assessment and management.
- To increase the participant's awareness and understanding that the mechanical integrity of process equipment depends jointly on the proper design, operation, condition assessment, and maintenance of the equipment.

Analyze engineering failures critically in a given design by considering all possible failure mechanisms (sometimes, these failure mechanisms may be competing with one another)

Course Outline:

Understanding Failures

- Machine Failure Analysis
- Wear and tribology
- Fatigue mechanisms
- Plain, tilt-pad and anti-friction bearing and seal failures

Failure Mechanics

- Wear & Failure Mechanisms
- Imperfections and Defects, Corrosion Mechanisms
- Failure Modes, Fatigue, Fretting, Creep & Thermal fatigue,
- Stress Corrosion Cracking, Other modes
- Material properties, and selection

- Carbon & Alloy steels, Nickel, Titanium, and Specialty alloys
- Aluminium, aluminium alloys, Copper, copper alloys
- Plastic piping, Alternative options-linings, cladding
- Limitations and safeguards, Material selection - economics-life cycle costing

Failure Prevention by Design

- Failure Causes - Design, Operation; Maintenance, Other Causes
- Material properties, and selection
- Physical properties and limitations of components
- Physical properties of steel and alloy piping and tubing
- Physical properties of fittings, Basic Design
- Pressure Vessels, Piping Systems, Liquid Storage Tanks
- Operation and Maintenance of Process Equipment
- Damage Mechanisms Affecting Process Equipment

Avoiding Failures

- Analysis and identification of failures
- FMEA and FMECA to identify failure modes and criticality analysis
- Trouble shooting techniques, Statistical analysis of failures
- Reliability, availability and maintainability

Understanding Planned Maintenances

- Planned Maintenance Concepts
- Introduction, Maintenance Strategies
- Planned Maintenance “ background and history
- Planned Maintenance Technologies “ an overview
- CMMS, Potential Failure Analysis
- Deciding which technologies to apply to avoid failures

Using Predictive Maintenance

- Vibration Analysis, Introduction to Vibration Analysis
- Frequency Analysis and the Fast Fourier Transform
- Vibration Transducers, Basic Failure Mechanisms with examples
- Vibration Standards and Alarm Levels, Vibration Diagnostics
- Amplitude Demodulation aka Enveloping, SSE, HFD, Peak-Vue
- Vibration on Rolling Element Bearings
- Resonance identification & cure
- Other Predictive Maintenance Techniques
- Infrared Thermography, Thermo graphic applications
- Passive Ultrasonic - contact and non-contact
- Ultrasonic Applications, Tribology oil analysis

Inspection, Assessment and Maintenance

- Inspection Strategies Plans and Procedures Risk Based Inspection (API 580)
- Developing an RBI Plan
- Fitness-For-Service Assessment (API 579)
- NDT Methods and Techniques
- Probability of Detection, Damage Characterization
- Selecting the correct technique(s)
- Pigging of Pipelines, Smart pigging
- Cleaning, Operational procedures.
- **Control Mechanisms**
- Managing Planned Maintenance
- Performance and Efficiency Monitoring
- Managing the Planned Maintenance effort
- Cost Analysis, Reporting Techniques
- Integrating Predictive Maintenance into the Maintenance Plan