Performance Monitoring Of Pumps & Compressors

Introduction:

As the process plants have got bigger, the machines have become larger in terms of their power ratings and complexity. At the same time, the demand for efficient operation and higher availability of these machines has been on the rise and this in turn has led to the adoption of modern maintenance strategies and practices by the industry, so that these objectives may be achieved. Condition monitoring of equipment is one best practice that has proven itself over the years. It is now considered an integral part of an effective plant asset management strategy.

Performance monitoring on the other hand is the thermodynamic and hydraulic evaluation of the equipment. This technique determines the efficiency with which energy conversions occur in the equipment. Performance calculations enable the computation of energy requirements of equipment. This helps in benchmarking their performance. In case gaps are noticed, this technique has the ability to troubleshoot equipment problems. It can also indicate equipment problems that may not be normally detected by mechanical health monitoring. When used together, they help provide efficient operation of the equipment and at higher availability levels.

Another utility of the performance monitoring technique is that the same theory and concepts can be employed in the sizing, selection and re-rating of the equipment. It thus becomes a useful tool especially during the process of

evaluation of technical bids. This course covers in detail, the technique of performance monitoring as applied to centrifugal pumps and positive displacement, centrifugal and axial flow compressors. The course includes a large number of practical examples that help to learn and clarify the concepts. These can then be readily applied to real machines in plants, to evaluate their present performance, benchmark with rated values and analyze the causes for the gaps. Additionally, examples involving sizing and selection of the equipment are also included.

It will highlight:

- Principles of operation
- Thermodynamic and hydraulic evaluation
- Important performance parameters and selection considerations
- Methods to derive the above from first principles and empirical relationships
- Handling gas and gas mixture properties
- Interpretation of results

Who Should Attend?

Anyone who deals with design, selection, sizing, operation and maintenance of pumps and compressors in the course of their work, Asset Managers, Contract Managers, Electrical Engineers, Maintenance Engineers, Maintenance Managers, Managers, Mechanical Engineers, Municipal and Regional Planners, Operations Managers, Professional Engineers, Project Managers, Reliability Engineers, Utility Advisors and Planners

Course Objectives:

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

- Optimizing equipment performance
- Performance monitoring strategies
- General hydraulic concepts in relation to performance monitoring

- Centrifugal pumps - construction, operational principles, selection criteria, power requirements, efficiencies and losses, characteristic curves, performance calculations
- Gas properties - thermodynamic concepts and processes, Thermodynamic and gas laws, ideal gases, computation of gas properties, gas power cycles
- Reciprocating compressors - construction, operation, compression terms, performance calculations, evaluating efficiencies and methods to estimate them, analysis of PV diagrams
- Centrifugal and axial flow compressors - design and operational aspects, compression terms, performance calculations, evaluating adiabatic and polytropic efficiencies and methods to estimate them

Course Outline:

Introduction and Fundamentals

- Equipment degradation and loss in efficiency
- Optimizing equipment performance and establishing best maintenance practices
- Introduction to performance monitoring
- Performance monitoring strategies and techniques
- Benefits of performance monitoring

Hydraulic Principles and Concepts

- General liquid characteristics and properties
- Concepts related to pressure, volume, flow, head and resistance
- Pascal's law and momentum equation
- Hydraulic power and pump efficiency
- Specific speed
- Cavitation, recirculation and Net Positive Suction Head (NPSH)
- Impact of jet on normally fixed plates, inclined fixed plates and hinge plates
- Impact of jet on a fixed curved vane, moving curved vane and series of vanes
- Velocity triangles

Centrifugal Pumps

- Principle of working of centrifugal pumps
- Centrifugal pump components
- Range of operation
- Selection considerations
- Multi-stage operation in centrifugal pumps
- Abnormal operation
- Power requirements, efficiencies and losses in centrifugal pumps
- Pump characteristic curves
- Improving pump reliability
- Performance calculations

Gas Properties and Thermodynamic Concepts

- Basic thermodynamic concepts
- Working substance and thermodynamic processes
- State of a system and its transformations
- Ideal gases
- Equilibrium state
- Overview of the various gas laws
- Laws of thermodynamics
- Gas power cycles

Reciprocating Compressors

- Principle of operation and construction of reciprocating compressors
- Classification of reciprocating compressors
- Mechanism of a single-stage reciprocating compressor
- Work done in a single-stage reciprocating compressor
- Multi-stage reciprocating compressors
- Work done in a multi-stage reciprocating compressor
- Volumetric efficiency and performance
- Achieving maximum efficiency in multi-stage reciprocating compressors

- PV diagrams and their analysis

Centrifugal and Axial-Flow Compressors

- Construction and principle of working of centrifugal compressors
- Classification of centrifugal compressors
- Design and operation of axial-flow compressors
- Efficiency and performance characteristics
- Adiabatic and polytropic efficiencies
- Methods used to evaluate efficiencies