

COURSE NAME: INDUSTRIAL PIPING SYSTEM

LECTURE XII-WEEK XII: PIPING SYSTEM BREAKDOWN

MAINTENANCE

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OBJECTIVES

By the end of this session the learner/student will be able to:

- ✓ Identify Piping System Breakdown Maintenance Activities
- ✓ Identify Piping System Maintenance Challenges
- ✓ Overcome Piping System Maintenance Challenges
- ✓ Elaborate Piping System Maintenance cost analysis

XII.1. Introduction

Piping system breakdown maintenance refers to the planned activities and procedures carried out to identify, address, and rectify issues or failures in a piping system. It involves repairing, replacing, or restoring the components of the piping system that have experienced breakdowns, such as leaks, bursts, corrosion, or other malfunctions. The goal of breakdown maintenance is to restore the functionality, integrity, and performance of the piping system while ensuring the safety of personnel and minimizing disruptions to operations.

XII.2. Piping System Breakdown Maintenance Activities

a. Identifying the Failure

- ✓ Determine the specific location and nature of the failure, such as a leak, crack, joint failure, or equipment malfunction.
- ✓ Conduct a visual inspection and perform preliminary assessments to understand the extent of the problem.

Piping System Breakdown Maintenance Activities Cont'd

b. Isolating the System

- ✓ Safely isolate the affected section of the piping system to prevent further damage or disruption.
- ✓ Close valves, disconnect equipment, and take necessary steps to stop the flow of fluids or isolate the system from the rest of the network.

Piping System Breakdown Maintenance Activities Cont'd

c. Assessing the Impact

- ✓ Evaluate the impact of the failure on system performance, safety, and surrounding equipment.
- ✓ Determine the potential consequences, such as production losses, safety risks, or environmental hazards.

Piping System Breakdown Maintenance Activities Cont'd

d. Emergency Repairs

- ✓ Perform immediate repairs or temporary fixes to restore the functionality of the piping system and minimize downtime.
- ✓ Replace damaged components, repair leaks, or address any other issues that caused the breakdown.
- ✓ Utilize suitable repair techniques based on the type of failure and available resources.

Piping System Breakdown Maintenance Activities Cont'd

e. Inspection and Testing

- ✓ Conduct thorough inspections of the repaired or replaced components to ensure their integrity and reliability.
- ✓ Perform non-destructive testing (NDT) techniques, such as visual inspections, ultrasonic testing, or magnetic particle testing, to detect any underlying issues or potential failures.

Piping System Breakdown Maintenance Activities Cont'd

f. Safety Checks

- ✓ Verify that the repaired section of the piping system meets safety standards and is free from any hazards.
- ✓ Conduct pressure tests, leak tests, or other appropriate tests to confirm the integrity of the repaired system before reactivation.

Piping System Breakdown Maintenance Activities Cont'd

g. Documentation

- ✓ Document the details of the failure, the repair process, and any modifications or adjustments made to the system.
- ✓ Maintain a record of the breakdown maintenance activities for future reference and analysis.

Piping System Breakdown Maintenance Activities Cont'd

h. Root Cause Analysis

- ✓ Perform a root cause analysis to determine the underlying reasons for the failure and prevent future occurrences.
- ✓ Identify contributing factors, such as corrosion, fatigue, inadequate maintenance, or design flaws, and implement corrective actions to address them.

It's important to note that while breakdown maintenance addresses immediate failures, it is generally more reactive and less cost-effective compared to preventive maintenance. Organizations should strive to minimize breakdown maintenance by implementing proactive strategies, such as regular inspections, preventive maintenance schedules, and condition monitoring techniques, to detect and address potential issues before they lead to breakdowns.

XII.3. Piping System Maintenance Challenges

Maintaining the integrity, performance, and reliability of piping systems comes with various challenges. These challenges can arise from factors such as system complexity, environmental conditions, aging infrastructure, and operational demands. Understanding these challenges is essential for developing effective maintenance strategies. Here are some common piping system maintenance challenges:

Piping System Maintenance Challenges Cont'd

a. Corrosion and Erosion

- ✓ **Corrosion:** Piping systems are susceptible to corrosion due to the interaction of metal surfaces with the transported fluids, leading to degradation, leaks, and reduced system lifespan.
- ✓ **Erosion:** High-velocity flows, abrasive fluids, or particulate matter can cause erosion of the pipe wall, leading to thinning, pitting, and potential failure.

Piping System Maintenance Challenges Cont'd

b. Leakage and Fluid restriction

- ✓ **Leakage:** Improper reinstallation of pipes, fittings, or seals can lead to leaks in the system. This can occur due to incorrect assembly, insufficient tightening, or damage to components during maintenance activities.
- ✓ **Flow Restrictions:** Improper alignment or installation of piping components can cause flow restrictions, leading to increased pressure drops, reduced flow rates, or inefficient system performance. It can result from misaligned pipes, partially closed valves, or obstructions in the piping system.

Piping System Maintenance Challenges Cont'd

c. Misaligned Pipes: Improper alignment of pipes during reassembly can cause misalignment at joints, resulting in stress, leaks, or potential failures over time. Misaligned pipes can also lead to increased vibration and fatigue.

d. Contamination: Introduction of foreign materials, debris, or contaminants into the system during maintenance can result in blockages, reduced flow, or damage to downstream equipment.

Piping System Maintenance Challenges Cont'd

e. Improper Valve Operation: Inaccurate adjustment or improper operation of valves during maintenance can lead to incorrect flow control, pressure imbalances, or inefficient system operation.

f. Equipment Damage: Inadequate handling or improper reinstallation of equipment such as pumps, compressors, or control devices can result in damage, misalignment, or malfunctioning of the equipment.

Piping System Maintenance Challenges Cont'd

g. Insufficient Lubrication: Failure to properly lubricate moving parts or valves during maintenance can cause increased friction, premature wear, or decreased performance.

h. System Imbalance: Failure to properly balance the system after maintenance, such as adjusting flow rates or pressure levels, can result in uneven distribution, reduced efficiency, or overloading of specific sections of the system.

Piping System Maintenance Challenges Cont'd

i. Human Error: Mistakes made during maintenance activities, such as incorrect measurements, misinterpretation of instructions, or oversight of critical steps, can result in system problems or failures.

j. Incomplete Documentation: Inadequate documentation of maintenance activities, including incomplete records, missing inspection reports, or incomplete work orders, can lead to a lack of visibility into the maintenance history and potential challenges in future maintenance activities.

Piping System Maintenance Challenges Cont'd

To mitigate these problems, it is crucial to follow proper maintenance procedures, ensure thorough inspections and testing, provide adequate training to maintenance personnel, and maintain clear and accurate documentation throughout the maintenance process. Regular post-maintenance checks and system performance monitoring can help identify and address any issues that arise after maintenance activities.

XII.4. Overcoming Piping System Maintenance Challenges

Piping system maintenance challenges can be effectively managed and overcome through proactive strategies and best practices. Here are some approaches to address common piping system maintenance challenges:

a. Use Proper Materials and Component Selection

- ✓ Select piping materials and components that are compatible with the fluid being transported and the environmental conditions.
- ✓ Consider factors such as corrosion resistance, temperature and pressure ratings, and long-term durability during material selection.

Overcoming Piping System Maintenance Challenges Cont'd

b. Implement a Preventive Maintenance Program

- ✓ Develop a comprehensive preventive maintenance plan that includes regular inspections, cleaning, lubrication, and component replacements based on recommended intervals and industry standards.
- ✓ Implement condition monitoring techniques such as vibration analysis, thermography, and corrosion monitoring to identify potential issues before they lead to failures.
- ✓ Conduct risk assessments to prioritize maintenance activities and allocate resources effectively.

Overcoming Piping System Maintenance Challenges Cont'd

c. Conduct Regular Inspections

- ✓ Perform routine inspections to identify corrosion, leaks, wear, and other signs of degradation.
- ✓ Utilize advanced inspection techniques such as non-destructive testing (NDT) methods to assess the integrity of pipes, welds, and fittings.
- ✓ Implement robust documentation and record-keeping practices to track inspection findings and maintenance actions.

Overcoming Piping System Maintenance Challenges Cont'd

d. Develop a Corrosion Management Strategy

- ✓ Apply corrosion control measures such as protective coatings, cathodic protection, and inhibitors to mitigate the effects of corrosion.
- ✓ Regularly monitor corrosion rates and implement corrosion monitoring programs to assess the effectiveness of control measures and make necessary adjustments.

Overcoming Piping System Maintenance Challenges Cont'd

f. Train and Educate Maintenance Personnel

- ✓ Provide training and ongoing education to maintenance personnel to enhance their knowledge of piping systems, maintenance techniques, and safety practices.
- ✓ Foster a culture of safety awareness and encourage personnel to report potential issues or hazards promptly.

Overcoming Piping System Maintenance Challenges Cont'd

g. Employ Best Practices for Repair and Maintenance

- ✓ Follow industry best practices and manufacturer recommendations for repairs, replacements, and maintenance procedures.
- ✓ Ensure proper installation techniques, including appropriate welding procedures, pipe alignment, and joint tightening.

Overcoming Piping System Maintenance Challenges Cont'd

h. Monitor and Control Fluid Flow

- ✓ Implement flow control devices such as flow meters, pressure gauges, and control valves to maintain optimal operating conditions.
- ✓ Regularly monitor flow rates and pressure drops to identify abnormalities that may indicate issues with the piping system.

Overcoming Piping System Maintenance Challenges Cont'd

i. Invest in Technology and Automation

- ✓ Utilize advanced technologies such as remote monitoring systems, predictive maintenance tools, and data analytics to optimize maintenance practices and detect potential failures in real-time.
- ✓ Explore automation options for routine maintenance tasks, such as robotic inspection or cleaning devices.

Overcoming Piping System Maintenance Challenges Cont'd

j. Maintain a Spare Parts Inventory

- ✓ Establish an inventory of critical spare parts to facilitate quick repairs and minimize downtime.
- ✓ Regularly review and update the inventory based on usage, equipment lifespan, and changes in operational needs.

Overcoming Piping System Maintenance Challenges Cont'd

k. Foster Collaboration and Communication

- ✓ Encourage collaboration between maintenance personnel, operations teams, and management to share knowledge, identify potential issues, and develop effective maintenance strategies.
- ✓ Maintain open lines of communication with equipment manufacturers, suppliers, and industry experts to stay updated on best practices and new technologies.

By implementing the above-mentioned practices, organizations can proactively address piping system maintenance challenges, improve reliability, extend the system's lifespan, and minimize the risk of failures, leaks, and costly repairs.

XII.5. Elaborate Piping System Maintenance Cost Analysis

Performing a piping system maintenance cost analysis involves assessing the expenses associated with maintenance activities and comparing them with potential savings and benefits. Here's a step-by-step guide on how to conduct a piping system maintenance cost analysis:

Elaborate Piping System Maintenance Cost Analysis Cont'd

a. Maintenance Activity Analysis

Identify the specific maintenance activities required for the piping system, such as inspection, cleaning, testing, lubrication, corrosion control, and component replacement. Analyze the frequency and scope of each activity based on industry standards, manufacturer recommendations, and system requirements.

Elaborate Piping System Maintenance Cost Analysis Cont'd

b. Labour Cost Estimation

Determine the labour hours required for each maintenance activity.

Estimate the number of personnel needed and their hourly rates.

Consider both in-house maintenance staff and any external contractors or specialized technicians required. Multiply the labour hours by the labour rates to calculate the labour cost for each activity.

Elaborate Piping System Maintenance Cost Analysis Cont'd

c. Material and Equipment Cost Estimation

Identify the materials, consumables, cleaning agents, lubricants, coatings, and replacement parts needed for maintenance activities. Estimate the quantities required and their associated costs based on historical data, vendor quotes, or industry averages. Include the costs of equipment, tools, or technologies needed for maintenance, such as inspection devices or testing instruments.

Elaborate Piping System Maintenance Cost Analysis Cont'd

d. System Downtime and Interruption Analysis

Assess the potential impact of maintenance activities on system downtime or production interruptions. Estimate the duration of system shutdowns or reduced production capacity required for maintenance. Calculate the associated costs, such as lost production revenue, additional labor required for shutdown and startup, or temporary measures implemented to minimize disruptions.

Elaborate Piping System Maintenance Cost Analysis Cont'd

e. Risk Reduction and Avoidance Analysis

Consider the potential cost savings resulting from the prevention of breakdowns, emergency repairs, or safety incidents through regular maintenance. Estimate the cost savings associated with avoiding downtime, repairing major failures, mitigating environmental or safety risks, or preventing regulatory non-compliance.

Elaborate Piping System Maintenance Cost Analysis Cont'd

f. System Longevity and Lifecycle Cost Analysis

Assess the potential cost savings achieved by extending the life of piping components and systems through maintenance. Estimate the deferred or minimized expenses related to replacements, major upgrades, or energy inefficiencies resulting from neglecting maintenance. Consider the impact on energy consumption, system efficiency, and overall lifecycle costs.

Elaborate Piping System Maintenance Cost Analysis Cont'd

g. Cost-Benefit Analysis

Compare the estimated maintenance costs with the projected savings and benefits identified in the previous steps. Consider factors such as reduced repair expenses, increased system reliability, extended component life, improved safety, compliance, and energy efficiency. Calculate the potential return on investment (ROI) and assess the cost-effectiveness of preventive maintenance measures.

By following these steps, you can estimate the piping system maintenance cost analysis for a piping system. This estimation will help you anticipate expenses, allocate resources efficiently, and make informed decisions regarding preventive and breakdown maintenance strategies.

THANK YOU!!!!!!!!!!!!

QUESTIONS AND ANSWERS

References

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