ENGINEERING TRAINER

Water Hammer Phenomena in Industrial Piping Systems

This water hammer course explains how transient pressure events develop in industrial piping and how system features affect their severity. Worked cases cover valve closure, pump trips, jetty lines, firewater and deluge systems, buried piping and mitigation measures. This self-paced online course includes video lectures and a completion certificate with PDH credits.

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ONLINE	SELF-PACED	1-YEAR ACCESS
7 MODULES	5.5 PDH	5.5 HOURS

TRUSTED BY ENGINEERING TEAMS WORLDWIDE

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What you'll learn

This course provides a comprehensive understanding of water hammer phenomena in industrial piping systems. It combines the essential theory behind transient pressure events with practical examples from process plants, jetty lines, pump systems, firewater systems, deluge systems, sprinkler systems, and buried piping networks.

The course starts with the principles of water hammer, including pressure wave propagation, wavespeed, the Joukowsky equation, valve closure behaviour, frictional damping, unbalanced forces, and cavitation. It then moves into practical industrial cases, showing how pump trips, pump start-up, valve operation, orifice selection, pressure losses, temperature effects, and boundary conditions influence pressure surge behaviour.

Throughout the course, you will learn how to identify vulnerable parts of a piping system, evaluate surge-sensitive locations, and assess mitigation strategies. The emphasis is on developing sound engineering judgment: understanding not only what happens during a water hammer event, but also why it happens and how it can be managed in real systems.

Skills you'll gain

- ✓ Explain the fundamental principles behind water hammer and pressure surge phenomena.
- ✓ Understand how pressure waves develop and travel through industrial piping systems.
- ✓ Apply the Joukowsky equation and understand its practical limitations.
- ✓ Calculate wavespeed and recognize the influence of pipe properties, fluid conditions, and system configuration.
- ✓ Evaluate the effect of valve closure, valve characteristics, pump trips, pump start-up, and pump switchover scenarios.
- ✓ Recognize cavitation risks and pressure collapse effects in transient events.
- ✓ Understand the role of pressure losses, boundary conditions, fluid temperature, buried piping, bends, tees, and branched systems.
- ✓ Identify critical surge-sensitive locations in piping systems, including process plants, jetty lines, deluge, firewater, and sprinkler systems.
- ✓ Assess mitigation measures and understand the trade-off between transient protection and steady-state system performance.
- ✓ Interpret practical water hammer case studies and use them to support better engineering decisions.

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About the Instructor

Dynaflow Research Group

Dynaflow Research Group is an engineering consultancy working across piping design and analysis, flow dynamics, vibration, FRP piping, pressure equipment and specialist engineering software. Its experience includes EN and ASME design rules for piping and pressure vessels, buried piping, water hammer, pulsation, dynamic stress assessment, vibration measurement, FEA tools, BOSfluids, BOSpulse, PV Elite and NozzlePRO workflows.

Who This Course Is For

- ✓ Piping engineers responsible for pressure-surge risks
- ✓ Process engineers assessing transient flow behavior
- ✓ Mechanical engineers working with pumps, valves or surge-sensitive equipment
- ✓ System design engineers responsible for firewater, deluge, jetty or process networks
- ✓ Integrity engineers reviewing water-hammer risks
- ✓ Technical reviewers assessing pressure-surge reports

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Course content

Module 1 - Water Hammer Physics

- What is water hammer?
- Friction: damping & line-packing
- The Joukowsky equation
- Unbalanced forces due to water hammer
- Cavitation in piping
- Cavitation in elevated piping sections
- Calculating the wavespeed
- Water hammer scenarios and risks

Module 2 - Simple Valve Closure Downstream of a Tank

- Principles of Water Hammer,
- Example 1a: Instant Valve Closing
- Unbalanced Loads in a closing valve scenario
- Joukowsky Equation, a closer look
- Example 1b: Joukowsky Equation

Module 3 - Valve Closure in a Jetty Line

- Module Overview
- Wave Speed in Pipes
- Valve Types and Closure Curves
- Example 1: Valve Types
- Cavitation, a closer look
- Example 2: Cavitation
- Example 3: Water Hammer in Jetty Line
- Outro

Module 4 - Pump Trips and Switchover in a Process Plant

- The pump trip scenario
- Results upstream and downstream of the pump (amongst others: pressure fluctuations, flow, unbalanced loads)
- The influence of pump moment of inertia and initial steady state flow
- Pump curves
- Cavitation downstream of the pump
- System (pump) start-up scenarios
- Good practices & pump properties

Module 5 - Orifice Selection in Deluge Systems

- Introduction
- Theory - Orifices
- Example A: Orifice in a Gas System
- Example B: Orifice in a Firewater System

Module 6 - Pressure Loss and Buried Systems

- Introduction
- Pressure Loss in a Straight Pipe
- Pressure Loss in Bends & Tees
- Boundary Conditions
- Impact of Wave Speed on Buried Systems
- Impact of Fluid Temperature
- Example: Water Hammer in a Buried Firewater System
- Summary

Module 7 - Mitigation Measures in Industrial Piping Systems

- Course Introduction
- Mitigation Measures
- Example: Pipeline Mitigation
- Example: Emergency Shutdown
- Summary