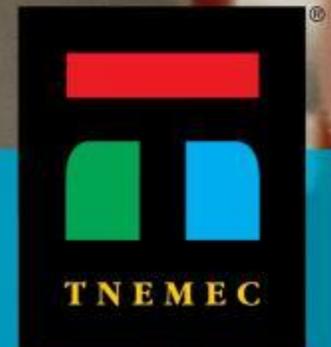


# NO SWEAT!

## AEROGEL-INFUSED INSULATING COATING FOR CONDENSATION CONTROL IN WATERWORKS



presented by  
Buddy Stanford



# PRESENTATION OUTLINE

- Condensation & general corrosion of pipe
  - Corrosion under insulation (CUI)
  - Overview of aerogel particles
  - Aerogel-infused insulating coatings for waterworks
  - Personnel Protection
  - Questions
- 

# **CONDENSATION & GENERAL CORROSION OF PIPING**

# CONDENSATION & GENERAL CORROSION

- WTP & WWTP pipe galleries
- Water tank fill pipes



# CONDENSATION IN GALLERY



**CORROSION UNDER INSULATION (CUI)**

# WHAT IS CUI?

- A severe form of localized corrosion due to entrapped water under the insulation layer of piping and vessels

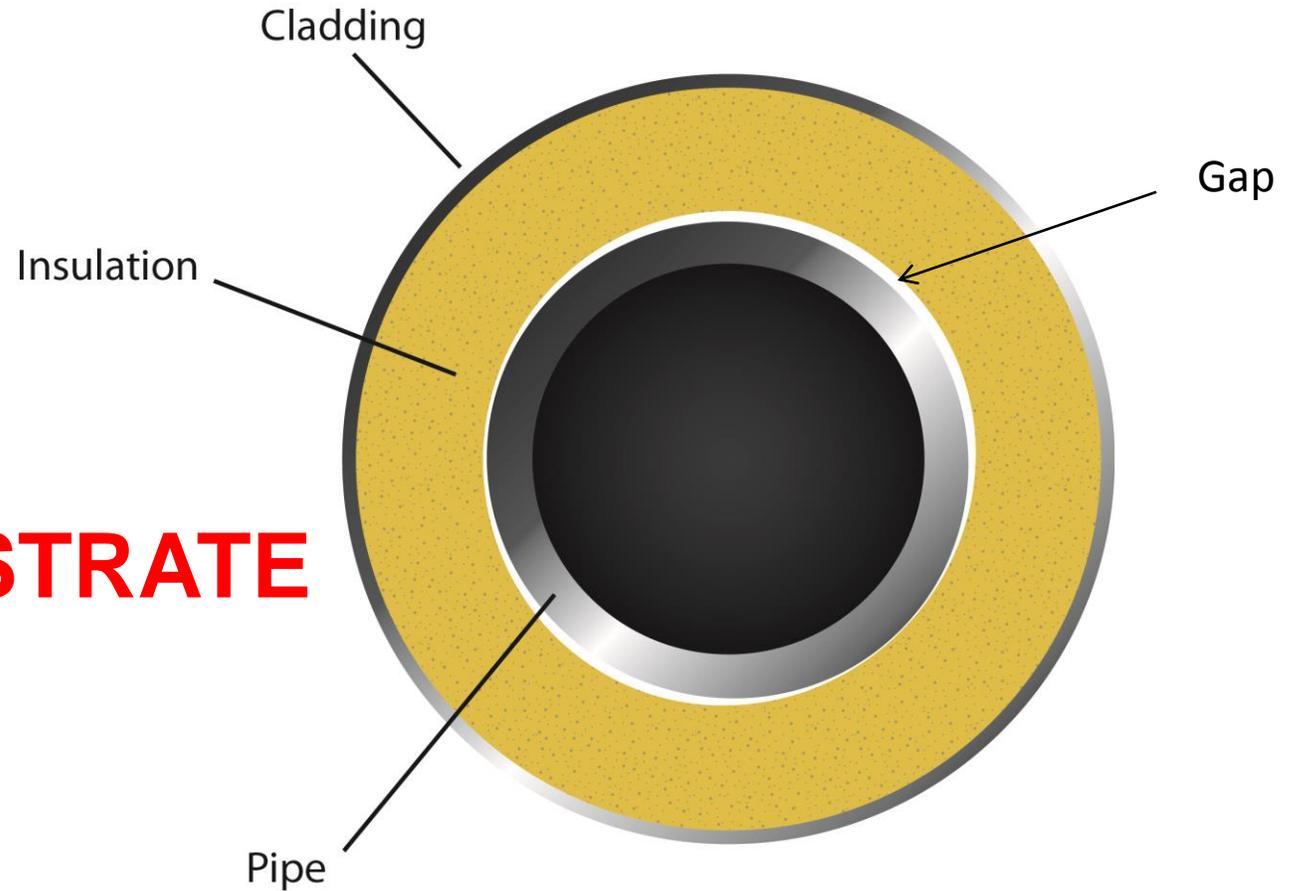


# PRIMARY CAUSES OF CUI

- Moisture
  - Condensation
  - External infiltration
- Temperature
  - 25°F to 250°F
- Oxygen Environment
  - Gap between substrate and insulation



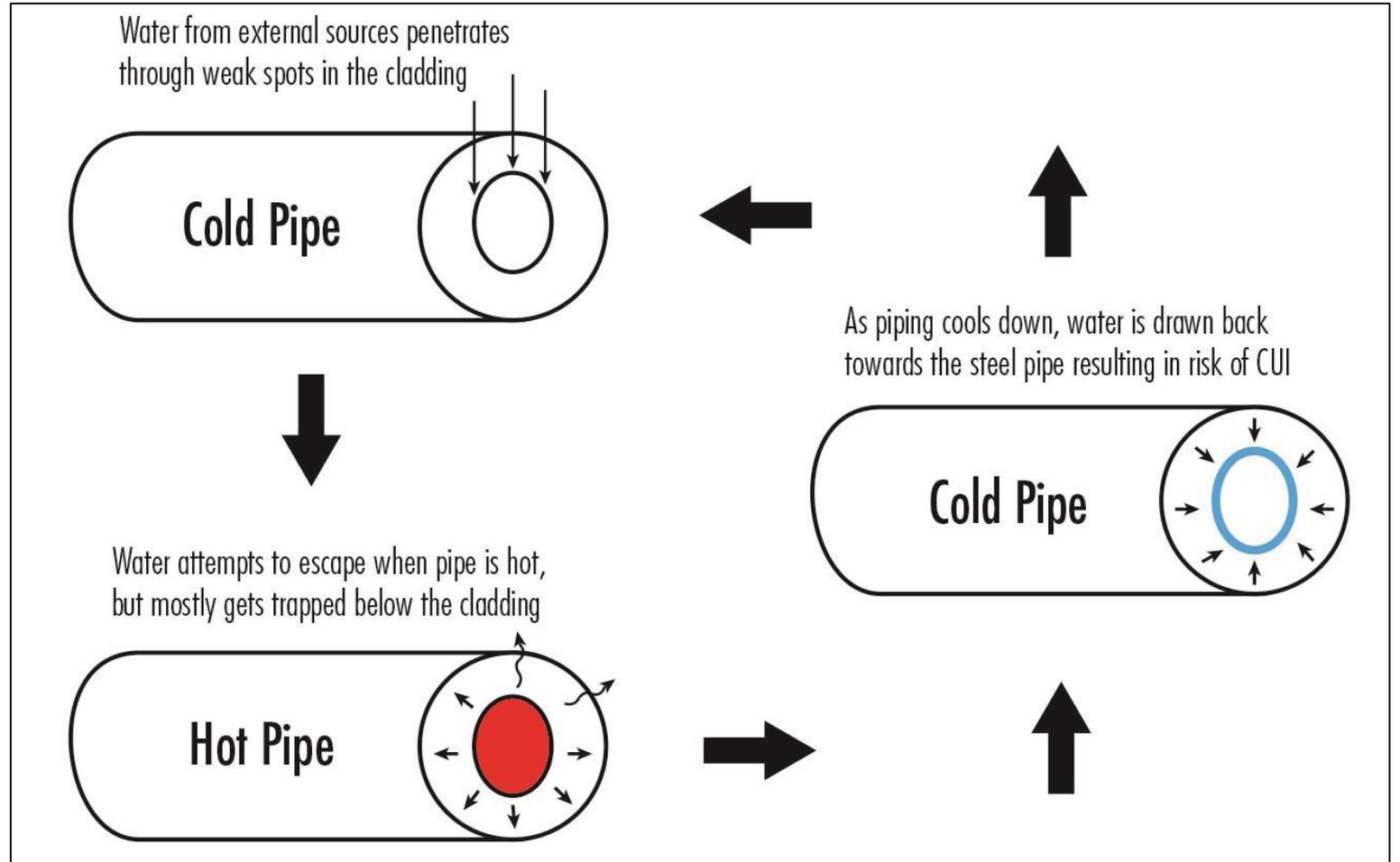
# AIR GAP BETWEEN INSULATION AND SUBSTRATE



# WET INSULATION



# THE CUI MECHANISMS



# CUI PREVENTION

- The impact of the energy loss due to wet insulation is often overlooked.
- Quote from Jan 2013 Materials Performance magazine:
  - “The absorption of as little as 4% (volume) water by dry insulation can increase the thermal conductivity by 70%.”

# INEFFECTIVE INSULATION & CORRODED PIPING



# 2012 DOE REPORT ON STEAM VALVES

U.S. DEPARTMENT OF **ENERGY** | Energy Efficiency & Renewable Energy

**ADVANCED MANUFACTURING OFFICE**

Energy Tips: STEAM Steam Tip Sheet #17

**Results:**

Annual Fuel Savings =  $5,992 \text{ Btu/hr} \times 8,760 \text{ hr/yr} / (0.80 \times 10^6 \text{ Btu/MMBtu})$   
= 65.6 MMBtu

Annual Dollar Savings =  $65.6 \text{ MMBtu/yr} \times \$8.00/\text{MMBtu}$   
= \$525 per 6-inch gate valve

DOE's software, the *Steam System Assessment Tool* and *Steam System Scoping Tool*, can help you evaluate and identify steam system improvements. In addition, refer to *Improving Steam System Performance: A*

- Report found a single 6" gate valve loses approx. \$525 in energy per year
- Valves are difficult and costly to wrap and clad
- Because of this, they are often left uninsulated
- Insulation coatings are a great solution

# CONDENSATION CONTROL

# IMPACT ON SURFACE TEMPERATURE

- Reduce condensation
  - High impact from minimal thickness
  - Insulation coating is bonded to the primer – no air gap
  - Can use 3E Plus modeling program to determine required thickness
    - Surface temp, air temp, and humidity

# CONDENSATION ISSUES

- Office space converted to a laboratory
- Standing water on inside of window frame

Laboratory – Boston, MA



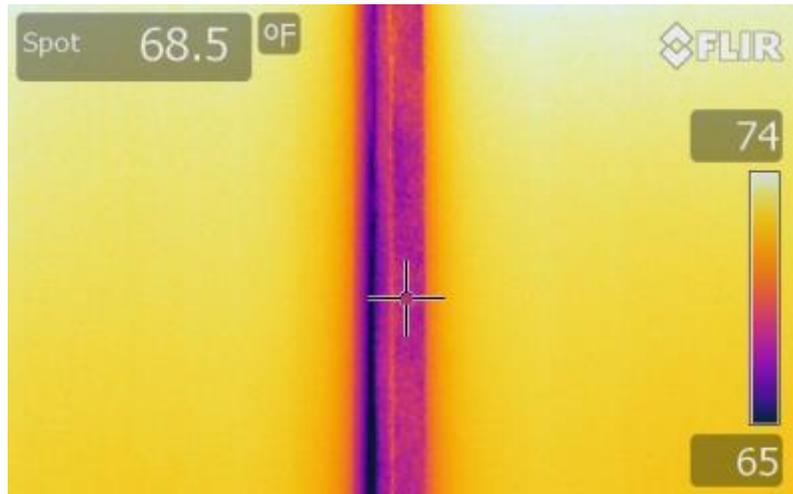




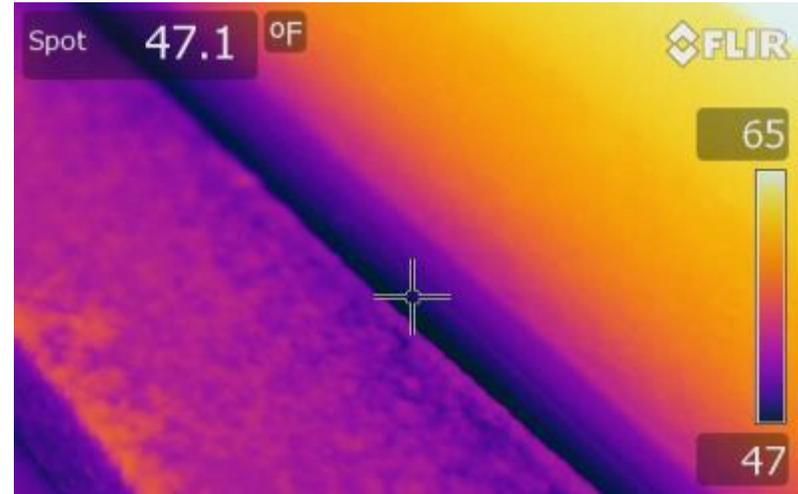


Condensation forming on gasket

# THE AEROLON DIFFERENCE



- Window with 100 mils of Aerolon
- 68.5°F (20°C) surface temp
- Exterior Temperature 28°F (-2°C)



- Window gasket with no Aerolon
- 47.1°F (8°C) surface temp
- Exterior Temperature 28°F (-2°C)

# **AEROGEL INSULATING PARTICLES**

# AEROGEL – WORLD'S MOST INSULATING SOLID

- Developed in the late 1930's
- Easy to produce in a lab, but difficult to manufacture in large quantities



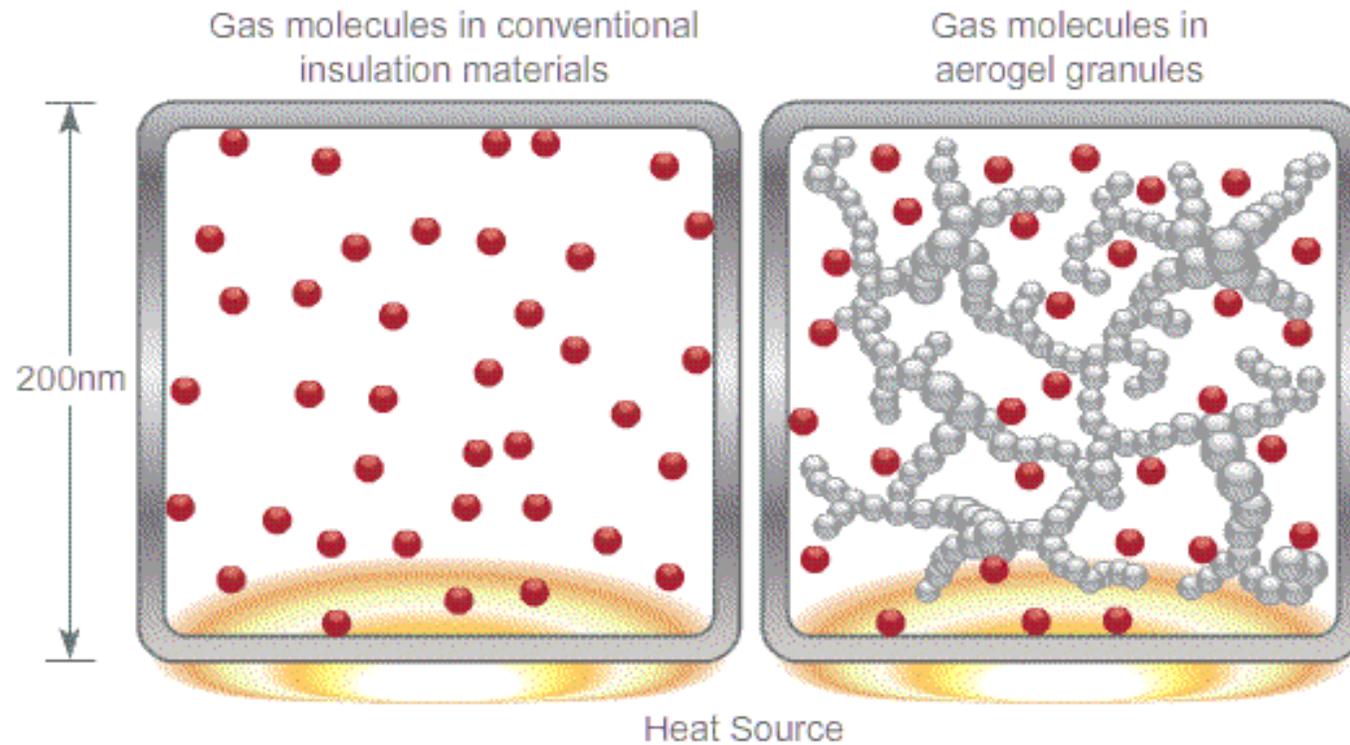
# AEROGEL - A UNIQUE MATERIAL

- Amorphous silica aerogel
- Particle sizes vary from microns to millimeters
- High porosity > 90% air
- Water repellent – super-hydrophobic
- Long and consistent service life
- Low thermal conductivity 12mW/mK



# CONDUCTION

- Transfer of heat from one molecule to another through a substance.



# CONDENSATION

- Dew point — the temperature at which air is completely saturated with water vapor. At this temperature, condensation will occur.
  - Relative humidity – measure of the amount of water in the air compared with the amount of water the air can hold at that temperature
- \*The surface temperature must be above the dew point to reduce condensation\*

# APPROACHES TO REDUCING CONDENSATION

- Traditional insulation
  - Absorb moisture from exposure to water from failed covering/jacketing
  - Gap between the insulation and the substrate
- Insulation Coatings
  - High impact from minimal thickness
  - Bonded to the primer – no air gap

# AEROGEL-INFUSED INSULATING COATING

- The marriage of time-tested coatings and aerogel
- Water-based Acrylic bonded coating
- Max operating temp 325°F (163°C)
  - Acrylic binder is the limiting factor
- Max application temp of 300°F (150°C)
- Tested with a variety of primers and topcoats
- Part of a complete coating system

# AEROGEL-INFUSED INSULATION COATING

- Condensation control
- CUI reduction
- Personnel Protection
- Energy efficiency



# **WATER TANK & WTP APPLICATIONS**

# WATERSPHEROIDS AND HYDROPILLARS

- Condensation control
  - Belly – interior dry portion
  - Access tube
  - Inlet pipe – part of a duplex system



# ILLINOIS

- New 500MG Waterspheroid
- Interior belly and access tube
- Epoxy primer/ 100 mils of Aerogel Insulation Coating / Epoxy topcoat



# FLORIDA

- New 750MG Pedisphere
- Interior dry belly
- Zinc-Rich primer/150 mils of Aerogel Insulation Coating/Epoxy topcoat
- Completed 2017



# ILLINOIS

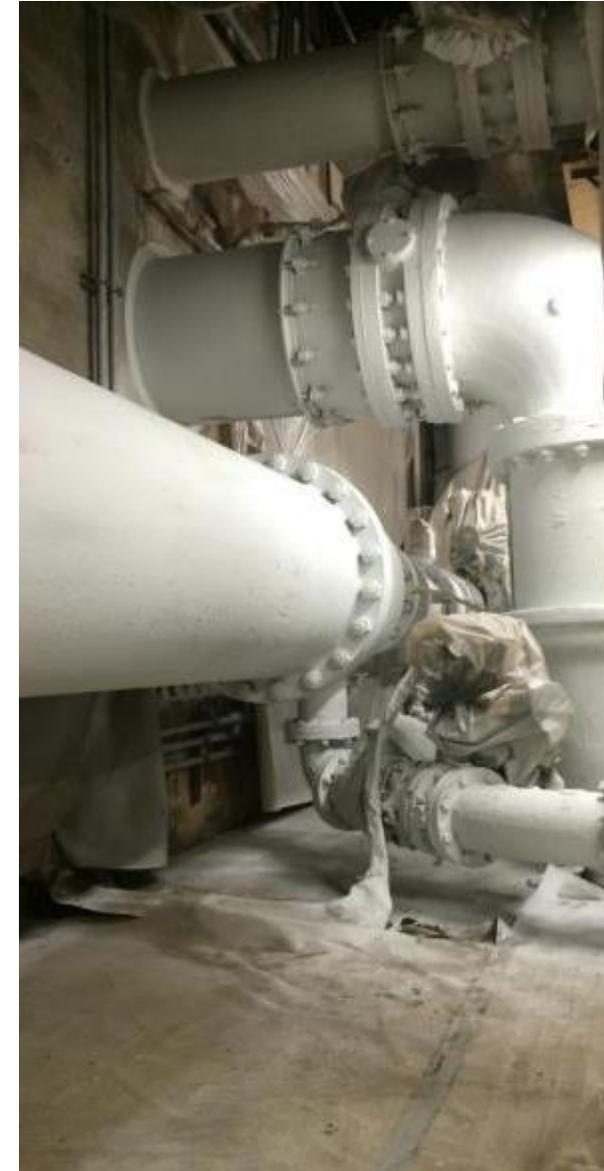
- New 1.0MG Concrete Elevated Tank (CET)
- Access tube application only
- Epoxy primer / 100 mils of Aerogel Insulation Coating / Epoxy topcoat



# PENNSYLVANIA

- Pipe gallery taking water from reservoir to treatment
  - Pipes sweat 6+ months out of the year
- Director of Operations for York Water
  - Reports no condensation since the install nearly two years ago

After scarifying the existing coating, they did some spot priming followed by a full prime coat – complete water-based system



**Pipe Gallery – York, PA**



**BEFORE**



**AFTER**



# ALABAMA

- Applied aerogel insulating coating at 100 mils based on modeling results



Plant – Douglas, AL

# ARKANSAS

- Aerogel Coating applied to pipe gallery
- Owner reports virtually zero condensation since install

Pipe Gallery – Russelville, AR



# NEW YORK

- Filter tanks
  - Inspection of the insulation found black mold and corrosion
  - Did not want to use traditional insulation as a result
- Water-based epoxy primer / 100 mils of Aerogel Coating / Water-based acrylic topcoat





# ARKANSAS

- Water Treatment Facility
- Aerogel Coating applied to pipe gallery



Pipe Gallery – Fort Smith, AR



Owner reports significant reduction in condensation since installation

**Pipe Gallery – Fort Smith, AR**

**PERSONNEL PROTECTION**

# WATERWORKS

- Concern for personnel protection on air motor and blower pipes
  - Tough geometry to insulate with conventional techniques



# WWTP — FINISH SHOT



# WWTP

- Aerogel-infused insulating coatings for waterworks
- Aeration pipe insulated for personnel protection
- Plant flooded – leading to an inspection of the insulation
  - Discovered CUI
- SP3 / WB epoxy / Aerogel coating / WB acrylic topcoat
  - Full water-based system



**BEFORE**



**AFTER**



# APPLICATION SHOTS

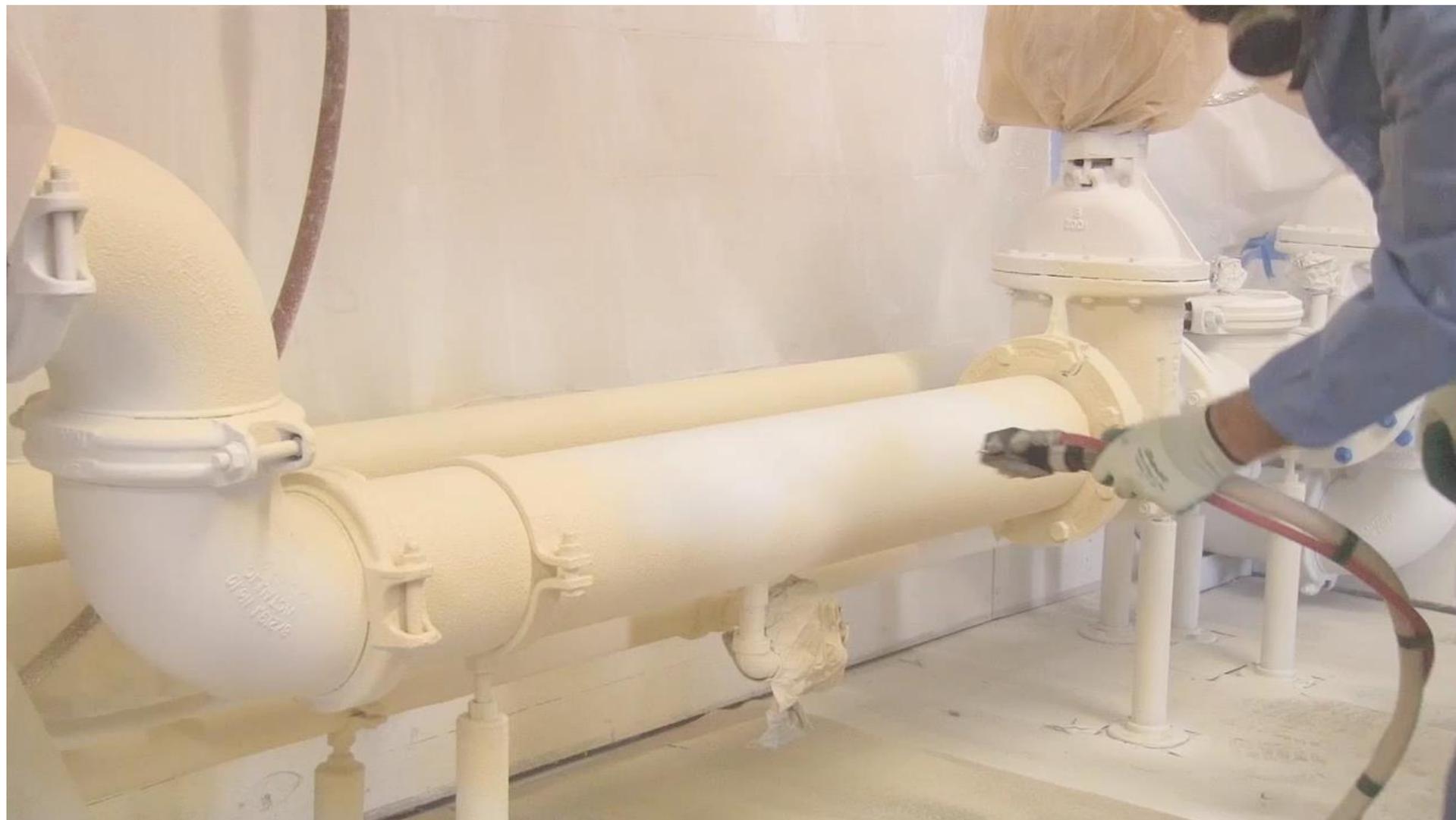
Aerogel coating spray applied to piping



# APPLICATION SHOTS

Aerogel coating spray applied to piping





# SUMMARY

- Aerogel-infused insulating coatings for waterworks
- By utilizing the best insulating solid in the world, aerogel-infused, bonded insulation coatings have an ultra low thermal conductivity
  - Very efficient at relatively low film thicknesses
  - Suitable for many different applications in the waterworks industry
    - Condensation Control
    - CUI Prevention
    - Personnel Protection
    - Energy Efficiency

QUESTIONS?

THANK YOU FOR YOUR  
PARTICIPATION.

