HVAC/R • PROCESS COOLING • BUILDING AUTOMATION

TECHTALK

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CASE STUDY: Extending Chiller Life Through Strategic Tube Rehabilitation

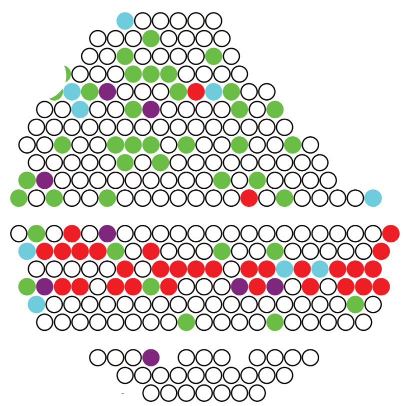
The Challenge

A large northern New Jersey medical facility's water-cooled centrifugal chiller was experiencing declining performance and increased maintenance issues. Based on MSC's proven track record and trusted relationships at sister facilities within their healthcare system, the facility management team selected us to perform a comprehensive assessment of their chiller's condition before deciding between costly emergency repairs, major rehabilitation, or complete replacement.

MSC's Diagnostic Approach

Our first step was comprehensive tube analysis using Eddy Current Testing (ECT) on both the condenser and evaporator tube bundles. This non-destructive testing method allows accurate assessment of tube wall thickness and identifies corrosion without dismantling the equipment.

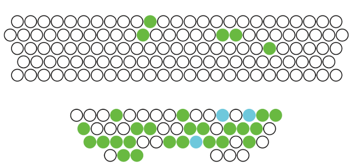
Condenser Tube Analysis (300 tubes total)



Eddy Current Testing revealed significant deterioration in the condenser tubes:

- ○ 213 tubes showed less than 10% wall thickness loss—acceptable
- ● 39 tubes had 10-20% wall thickness loss—monitoring required
- ● 9 tubes showed 21-34% loss—intermediate concern
- ● 8 tubes had 35-49% loss—approaching failure
- ● 31 tubes had 50% or greater loss—replacement required

Evaporator Tube Assessment



ECT indicated that the evaporator tubes were in much better condition, with 145 tubes showing minimal corrosion and only 3 requiring monitoring. No immediate action was recommended for the evaporator system.

Our Strategic Recommendation

Rather than replacing the entire chiller—a major capital expense with long lead times—MSC prescribed targeted rehabilitation:

1. Condenser tube replacement of the 48 most deteriorated tubes to restore heat transfer efficiency
2. Epoxy coating application to tube sheets to prevent future erosion and corrosion
3. Continued monitoring of evaporator tubes through annual ECT as part of preventive maintenance

Continued on page 2

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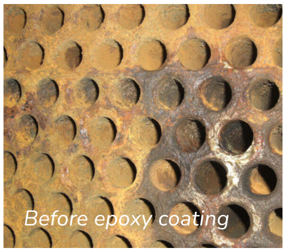
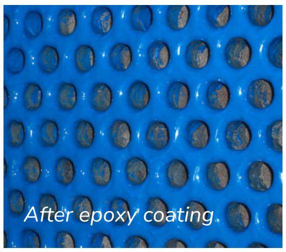
Extending Chiller Life with Retubing and Epoxy Coating – Continued

The Rehabilitation Process



Before epoxy coating



After epoxy coating

The condenser tube replacement involved systematic extraction of all existing tubes while maintaining the integrity of the shell and internal components. The 48 condenser tubes were replaced using controlled expansion and industrial adhesive, followed by comprehensive quality verification. The end bells were then protected with a specialized multi-layer epoxy coating system applied under controlled environmental conditions and tested for coating thickness, coverage, and adhesion.

Pressure Testing Reveals Hidden Evaporator Issues

Once the condenser rehabilitation was completed, we pressure-tested the condenser tubes and they passed all pressure specifications with no detectable leaks. As part of our thorough approach, we also pressure-tested the evaporator tubes. Unexpectedly, the pressure testing revealed leaks in the evaporator tube system that the ECT had missed.

Upon further analysis by our technicians, we found that the leaks were occurring at the tube ends where they were sealed—an area that eddy current testing cannot effectively assess. We immediately showed these leaks to the customer and recommended replacement of all evaporator tubes and epoxy coating of the evaporator end bells, which they accepted.

Complete Solution

What began as a condenser-focused rehabilitation became a comprehensive chiller restoration, addressing both visible and hidden deterioration throughout the system. This comprehensive rehabilitation approach provided the customer with:

- Significant cost savings: Tube replacement cost approximately 70% less than chiller replacement
- Improved efficiency: New tubes and protective coatings restored heat transfer performance
- Extended equipment life: Retubing can provide 15-20 years of additional service
- Verified reliability: Pressure testing ensured no hidden leaks that could cause future failures
- Future protection: Periodic ECT monitoring prevents future surprises

The Bottom Line

This case demonstrates the importance of comprehensive testing beyond standard diagnostics. While eddy current testing identified the obvious condenser issues, pressure testing revealed critical evaporator problems that would have caused future failures. Through advanced diagnostics, strategic rehabilitation, and thorough verification testing, this customer transformed a potential equipment crisis into a planned maintenance success. Their chiller now operates like new at a fraction of replacement cost, with complete confidence in its reliability.

Key Takeaway

Sometimes the most thorough diagnostic approach reveals issues that individual testing methods miss. MSC's commitment to comprehensive testing—including pressure testing even when ECT results look good—ensures customers get complete solutions rather than partial fixes. MSC's combination of diagnostic expertise, thorough testing protocols, and engineering support enabled us to provide a comprehensive solution that maximized this healthcare facility's equipment investment while ensuring reliable operation for years to come.

Paul Natiello Retires After 36 Years of Dedicated Service

On May 30, 2025, we wished a fond farewell to longtime employee Paul Natiello, who retired after an incredible 36 years with MSC.

When Paul started with us in May 1989, HVAC technology looked vastly different than it does today. Through all the industry changes, Paul consistently excelled, becoming one of our most trusted technicians. His dedication earned him respect from our entire team and countless customers over the decades.

Paul, thank you for 36 years of exceptional service and being such an integral part of our team. Enjoy your retirement, your wonderful family, and plenty of quality time at the hockey rink.

Understanding Glycol in Process Cooling and HVAC: Properties, Applications, and Essential Maintenance

WHAT IS GLYCOL?

Glycol is a type of chemical compound characterized by having two hydroxyl (OH) groups attached to different carbon atoms. The most common types used in HVAC and industrial applications are:

Ethylene glycol ($C_2H_6O_2$): A viscous liquid with a sweet odor and typically colored for identification purposes. It has excellent heat transfer properties and is commonly used as an antifreeze but is toxic if ingested.

Propylene glycol ($C_3H_8O_2$): A less toxic alternative to ethylene glycol with similar properties. It's considered safer for applications where there might be human contact or environmental concerns. "Food-grade" propylene glycol refers to a high-purity version that meets FDA requirements for incidental food contact, making it the preferred choice in applications where safety is paramount.

In HVAC and process cooling systems, glycol is typically mixed with water to create a solution that:

- Lowers the freezing point of water (preventing pipe bursts in cold conditions)
- Raises the boiling point (allowing for higher temperature operation)
- Provides corrosion inhibition when properly formulated with additives
- Maintains effective heat transfer properties

The concentration of glycol in the water mixture determines the freezing point protection, with higher concentrations providing protection at lower temperatures.

Continued on page 4

Understanding Glycol in Process Cooling & HVAC (continued)

COMMON APPLICATIONS

Glycol is commonly used in:

- Chilled water systems
- Hot water systems
- Heat recovery loops
- Thermal energy storage

Its ability to lower water's freeze point allows HVAC and process cooling systems to operate efficiently in various climates, significantly reducing the risk of freezing.

DESIGN CONSIDERATIONS

HVAC and process cooling design engineers must account for several factors when working with glycol systems:

- **Temperature Range**: Consider both freeze point and boiling point temperature ranges for system operation.
- **Material Compatibility**: Ensure long-term compatibility with pumps, piping, and heat exchangers.
- **Viscosity Management**: Account for glycol's increased viscosity, measured in centipoise (cP), particularly in pump selection. This is especially important at lower temperatures where viscosity increases significantly.
- **Heat Transfer Optimization**: Design for appropriate flow rates to optimize heat transfer, especially in heat exchangers.
- **Piping Configuration**: Minimize pressure drops, avoid dead spots where glycol can stagnate, and ensure proper insulation R-value to reduce heat loss.
- **Emergency Planning**: Consider emergency power for circulating pumps or incorporate freeze protection pumps where applicable.

INSTALLATION AND COMMISSIONING

Chilled water and hot water systems typically undergo several important steps during installation and commissioning:

- Pressure test chilled water and hot water systems
- Clean systems with solutions like trisodium phosphate (TSP)
- Add glycol with rust inhibitor mixed to a specific freeze protection point
- Circulate for a designated period
- Verify the specified freeze point using a digital refractometer

MAINTENANCE REQUIREMENTS

All glycol systems require specific preventive maintenance (PM):

Continued on page 5

- **Concentration Monitoring**: Glycol concentrations typically decrease over time to levels that provide inadequate freeze protection. While the primary cause is often maintenance activities where portions of the system are drained and refilled with water only (without adjusting the makeup system's glycol-water mixture), some glycol can also be lost through small leaks, venting, or chemical breakdown over extended periods. If the glycol concentration becomes too diluted, the system loses its freeze protection capabilities, putting pipes and equipment at risk during cold conditions.

- **Regular Testing**: Regular testing of glycol freeze protection points is essential for system reliability. Using digital refractometers or other appropriate testing equipment, maintenance personnel should verify that the glycol solution maintains the proper freeze point specified in the system design. Seasonal testing is particularly important, especially before cold weather periods. Besides freeze protection, regular testing can also reveal issues with pH levels and inhibitor concentrations that could lead to corrosion within the system. Establishing a consistent testing schedule as part of the preventive maintenance program helps prevent system damage and extends equipment life.

- **Flow Verification**: Proper flow rates are essential for optimal heat transfer in glycol systems. Regular verification using circuit balancing valves or an ultrasonic flow meter ensures the system is operating at design specifications. Inadequate flow can lead to poor heat transfer, while excessive flow can cause erosion and unnecessary pump energy consumption. Periodic flow testing also helps identify potential blockages, air entrapment, or pump performance issues before they develop into larger problems.

- **Performance Checks**: Thermal imaging provides valuable insights into the performance of heat exchange equipment. By scanning coils, heat exchangers, and piping systems, maintenance personnel can identify uneven heat distribution, blocked passages, air pockets, or fouling that might not be apparent through other testing methods. These proactive inspections can identify inefficiencies before they impact overall system performance, helping maintain optimal energy efficiency and extending equipment life.

THE BOTTOM LINE

Glycol systems are essential for reliable HVAC operation in climates where freezing is a concern, but they require ongoing attention to maintain their effectiveness. The key to long-term success lies in establishing a comprehensive maintenance program that includes regular concentration testing, flow verification, and performance monitoring.

By staying proactive with these maintenance requirements, facility managers can ensure their glycol systems provide years of reliable freeze protection while maintaining optimal energy efficiency. A modest investment in regular glycol testing and maintenance far outweighs the potential costs of system damage from inadequate freeze protection or poor heat transfer performance.