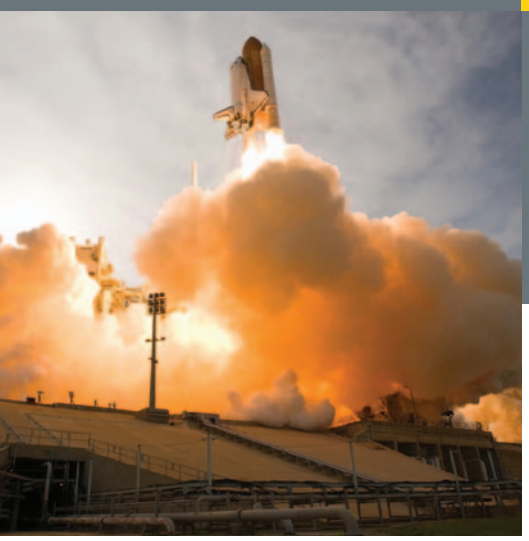

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The U.S. Department of Energy's (DOE) Federal Energy Management Program (FEMP) facilitates the Federal Government's implementation of sound, cost-effective energy management and investment practices to enhance the nation's energy security and environmental stewardship.

NASA MARSHAL SPACE FLIGHT CENTER IMPROVES COOLING SYSTEM PERFORMANCE

Best Management Practice Case Study #10: Cooling Towers

Established in 1960, National Aeronautics and Space Administration's (NASA) Marshall Space Flight Center (MSFC) is located in Huntsville, Alabama, adjacent to Redstone Arsenal. MSFC has over 4.5 million square feet of building space occupied by 7,000 personnel, and consumes approximately 240 million gallons of potable water annually, supplied through the City of Huntsville.

MSFC has a longstanding sustainability program that revolves around energy and water efficiency as well as environmental protection. In 2005, MSFC built Building 4600, NASA's first certified building under the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) rating system, achieving a prestigious Silver rating. Since that time, a companion building has been constructed at MSFC that achieved a Gold LEED rating. MSFC is also one of the first NASA sites to pursue LEED for Existing Buildings: Operation and Maintenance (LEED EB: O&M) certification, where buildings are sustainably operated and maintained to include water-efficient technologies, energy system commissioning, green cleaning, and recycling.

Project Summary

This case study highlights MSFC's implementation of new water treatment technologies to improve the efficiency and performance of one of their cooling systems. MSFC identified a problematic cooling loop with six separate compressor heat exchangers and a history of poor efficiency. The facility engineering team at MSFC partnered with Flozone Services, Incorporated to implement a comprehensive water treatment platform to improve the overall efficiency of the system.

MSFC Cooling System Project Goals:

1. Increase cycles of concentration to improve water efficiency.
2. Eliminate scale and bio-fouling in the cooling system.
3. Eliminate condenser-side chemicals to reduce operating costs and environmental impacts.

Technology Research

First, the team at MSFC identified a service provider and technology platform to better manage the cooling program on the inefficient cooling loop. The water treatment platform included 24/7 monitoring and management of cooling system performance, and real-time adjustments if needed. Traditional chemical treatments were replaced by a patented technology that utilizes radio frequencies to alter the water's scaling tendencies by creating a "seeding" mechanism that agglomerates scale-forming minerals in the water. This technology removes minerals before they can be deposited on heat exchange surfaces. Additionally, ozone was implemented to minimize biological activity resulting from ozone's strong oxidizing characteristics. Tight control of pH levels coupled with tight control of ozone production provided corrosion control, and side-stream filtration was integrated to remove sediment and debris from the recirculating system water.

To demonstrate the technology's capabilities, three heat exchangers were sent off site to be treated by the proposed system. The technology demonstration showed marked improvement after only 48 hours. Because of the success of this demonstration, MSFC opted to have all three heat exchangers cleaned for a 90-day time period.

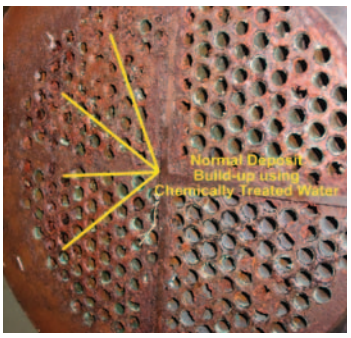

Figure 1. Low-Pressure Compressor 1 Heat Exchanger prior to water treatment demonstration (Courtesy of Flozone Services)

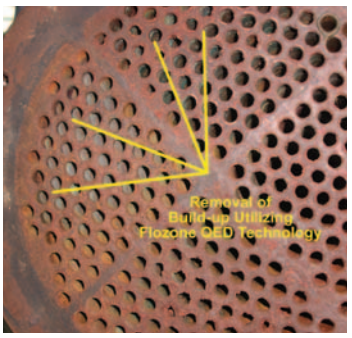

Figure 2. Low-Pressure Compressor 1 Heat Exchanger after 48 hours of water treatment (Courtesy of Flozone Services)

Performance Baseline and Improvement Projections

Prior to implementation, electricity, water, and sewer consumption data were collected to establish a baseline. Additionally, numerous water tests were performed on the cooling system and raw water to fully understand system performance along with existing water quality considerations. This particular cooling loop was running at 2.5 cycles of concentration, and used 4,142,400 gallons of water and 9,896,000 kilowatt-hours (kWh) of electricity in 2008. After assessing system performance, Flozone Services projected savings of 420,808 gallons of water over eight months by increasing cycles of concentration to 5.0.

Technology Implementation

The treatment platform was integrated at the beginning of August 2009, while the cooling loop was in operation. Prior to installing the treatment platform, the three heat exchangers cleaned during the technology demonstration period were re-installed in the system. The remaining three heat exchangers were inspected but not cleaned prior to implementation of the new treatment system. These three heat exchangers had extensive deposits and bio-fouling present. Inclusive of the treatment platform, software was implemented to allow control and monitoring from multiple locations, including the central operations computer and a backup computer in a different control room. Incremental changes were made to the system set points and alarms to allow the treatment platform to slowly increase cycles of concentration and gradually remove historical deposits and bio-fouling. This approach ensured system strainers weren't clogged with debris.

Performance Improvements

Water usage and energy usage were tracked for an eight-month period in 2009 and compared to the same timeframe in 2008. Figure 3 illustrates the water usage of the system, and Figure 4 reveals the electrical consumption over the same time period. Both trends show cumulative savings as MSFC achieved reduced water consumption of 821,300 gallons and reduced electrical consumption of 434,900 kWh during the eight-month technology assessment.

By implementing a comprehensive water treatment platform, MSFC successfully eliminated treatment chemicals in the selected cooling loop, removed historical deposits and bio-fouling from heat exchanger surfaces, and lowered operating temperatures on the heat exchangers between 5°F and 6°F. The resulting eight-month documented savings exceeded expected savings in every category.

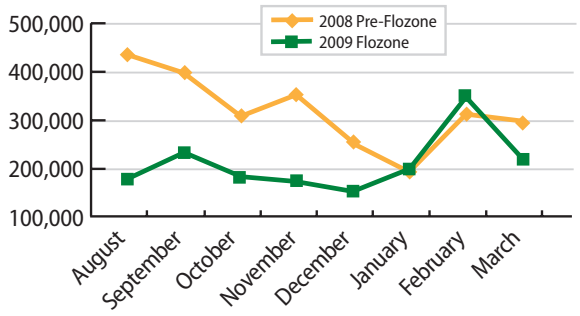

Figure 3. Water usage (gallons) comparison

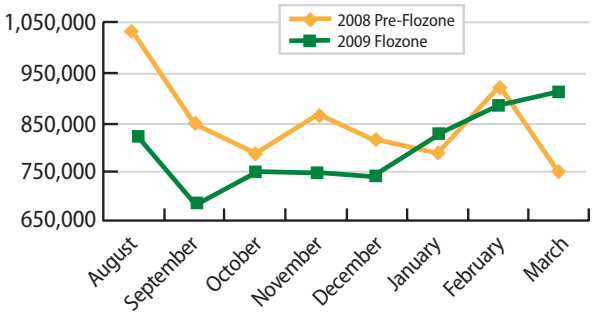

Figure 4. Energy usage (kWh) comparison

Table 1. MSFC Cooling Loop Performance

Expected Performance	Actual Performance
• Increase cycles of concentration to 5.0	• Increased cycles of concentration to 5.7
• Reduce water usage by 420,808 gallons	• Reduced water usage by 821,300 gallons
• Reduce water/sewer bill by $2,891	• Reduced water/sewer bill by $5,650
• Eliminate chemical treatments	• Eliminated chemical treatments
• Maintain current electrical consumption	• Reduced electrical demand by 434,900 kWh • Reduced electrical bill by $27,399

For More Information:

- Marshall Space Flight Center: www.nasa.gov/centers/marshall
- FEMP Water Efficiency Program: www.femp.energy.gov/program/waterefficiency.html
- Flozone Services, Incorporated: www.flozone.com

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