Water reduction through better rinse flow control

Federal Cartridge made several successful changes to their washer systems in 2006. By adding rinse control mechanisms recommended by a MnTAP intern, Federal Cartridge reduced water usage by 10% per year of annual use.

Company Description

Federal Cartridge Company, located in Anoka, Minnesota, has been manufacturing small arms ammunition for over 80 years. The company is a wholly-owned subsidiary of ATK, Alliant Techsystems, based in Eden Prairie, Minnesota.

Process Description

Small arms ammunition manufacturing involves a number of mostly automated metalworking operations, including stamping and drawing shell casings, annealing, and bullet forming. These operations require machining lubricants, coolants, and chemical baths for pickling and plating parts. Oily materials and debris from the bullet forming process must be removed between the automated operations and before the final product is delivered.

Federal Cartridge uses water to clean parts in a variety of washes and rinses using continuous drums and batch tubs. To control the water flow, Federal Cartridge uses a number of systems that take advantage of conductivity sensors to control diaphragm solenoid valves, and parts flow switches to control electric solenoid valves. However, these systems proved to be unreliable over time and required frequent maintenance to keep them in operation. Many of the reliability problems can be attributed to the hard well water used at the facility.

Incentives for Change

Federal Cartridge pumps process water from wells for use in their manufacturing line and an on-site wastewater treatment plant treats process effluent. In 2005, the company spent $205,000 treating the effluent and was approaching the hydraulic capacity of the treatment plant. Unless Federal Cartridge could reduce water consumption, production would be limited at the facility. This was a concern as the facility was intending to increase production. Due to the rising costs and the potential cap on production, Federal Cartridge applied for a MnTAP intern to help reduce the water used in the manufacturing process and ultimately increase the treatment plant capacity that was needed.

MnTAP intern Brent Kastern analyzed Federal Cartridge water use in washer systems and made recommendations that saved $22,300 annually in costs.

Loss Mechanisms

The MnTAP intern first measured the water used in each process and then focused his efforts on analyzing the processes that use the most water and recommending solutions for reducing water use.

Sinterite

The Sinterite machine anneals, washes, rinses, and lubricates the metal that is then stamped into ammunition casings. This machine, the largest single water user, accounts for 8% of the plant's annual effluent. Originally, rinse water use on the Sinterite was controlled with a conductivity controller and a diaphragm solenoid valve. The poor incoming water quality at Federal Cartridge resulted in scale and solids buildup, which quickly clogged the sensor and valve. To avoid the buildup, operators bypassed the controls with a continuous high flow of water.

Benefits Overview

Waste Reduction Option	Waste Reduced/ Materials Savings	Annual Cost Savings
Washer system improvements	10% per year of annual use	$22,300

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When determining if operators should be required to control the water flow, the intern learned that conductivity is an imprecise control method for non-ionic oils and wash chemicals. Therefore, rather than replacing the conductivity controller and solenoid valve with another that would quickly clog, the intern developed a solution that used a timer and a mechanical pneumatic ball valve. After testing the system, the ball valve system was set to add a small fixed amount of fresh water to the rinse tank, based on measurements taken before the conductivity control was replaced. The ball valve has functioned without failure for three years and has resulted in a 98% reduction in water use at this operation. This saved Federal Cartridge $16,000 per year at an implementation cost of only $530.

Salems

The three Salem machines at Federal Cartridge anneal metals, expose them to an acid-cleaning bath, and then rinse and lubricate them prior to downstream metalworking operations. Together the Salem machines generate another 8% of water effluent to waste treatment. Much like the Sinterite machine, water conservation technology was built into these machines, but was unable to withstand the hard water at Federal Cartridge. As a result, there were frequent breakdowns of the solenoid valves that limit water flow into the rinse section. While waiting for the valves to be repaired, operators would add a hose to the rinse tank and leave it running continuously. Together, the three Salem machines were found to use as much water per year as the Sinterite machine because of the faulty conservation devices.

The MnTAP intern recommended the facility implement a pneumatically controlled ball valve to the Salem machines also. In this case, an additional limit switch was integrated into the valve control that turns water off when no parts are being processed. This reduced the number of hours that water is used per week from 168 to approximately 100 hours. It reduced the overall water consumption for the three Salem machines by 60% annually at an installed cost of $1,000. However, the timed rinse on each Salem was bypassed with a manual rinse in 2008 due to pipe corrosion from acid over-use. Federal Cartridge is currently working to reduce acid use and is planning efforts to optimize and reduce rinse consumption.

Ransohoff

The Ransohoff machine is used to wash lead bullets with a heated aqueous wash followed by a rinse. This operation accounts for 1% of the effluent to waste treatment. Previously, the rinse was controlled by a manual ball valve and flowed continuously at approximately one gallon per minute. Working with an experienced operator, the intern determined that fresh rinse flow for five minutes an hour gave acceptable results; therefore a timer and ball valve rinse were implemented. These changes resulted in a 91% reduction in water use in this operation per year at an installed cost of $510.

Colt Washers

Federal Cartridge uses two Colt washers that clean brass during various stages of the cartridge case manufacturing process. Rinse flows averaged a little over one gallon per minute continuously, and the two washers consumed 2.5% of the total plant water use per year. Timers and ball valves were implemented on these washers after a follow-up project completed in 2007 by Federal Cartridge staff determined timer settings for products processed by each washer. Controlling rinse flow on these washers reduced the operation's water consumption by over 80% annually at an installed cost of $1,000.

JIT Inline Washers

There are 21 inline washers that consist of a horizontal drum washer that feeds a drum rinse and, in turn, feeds a drum dryer. These wash stations clean a wide variety of shell casings after they are shaped. Rinse flows averaged a little over one gallon per minute continuously. The 21 washer stations consumed about 27% of the facility's total annual water usage. Proposals for timed rinse systems were made but are currently pending. The proposed rinse control has the potential to reduce the annual water consumption of these washers by 41% at an installed cost of approximately $11,300.

Results and Benefits

As a result of the MnTAP intern project, Federal Cartridge permanently installed rinse control on four washer systems at a cost of $2,040. Water reduction is currently being achieved on three of those systems. Water consumption was reduced by about 10% of the plant total discharge, for a total savings of $22,300 per year. Each project had a payback of six months or less. The reduced hydraulic loading also gave Federal Cartridge the operating margin they needed to meet their business goals. Work in two additional areas is pending that could reduce plant water use by another 15% from 2006 usage totals and has the potential to save an additional $33,000 per year.

For More Information

MnTAP has a variety of technical assistance services available to help Minnesota businesses implement industry-tailored solutions that maximize resource efficiency, prevent pollution, increase energy efficiency, and reduce costs. Our information resources are available online at <mntap.umn.edu>. Please call MnTAP at 612.624.1300 or 800.247.0015 for personal assistance or more information about MnTAP's Intern Program.

This intern project was conducted in 2006 by Brent Kastern, a senior chemical engineering student at University of Minnesota Duluth.