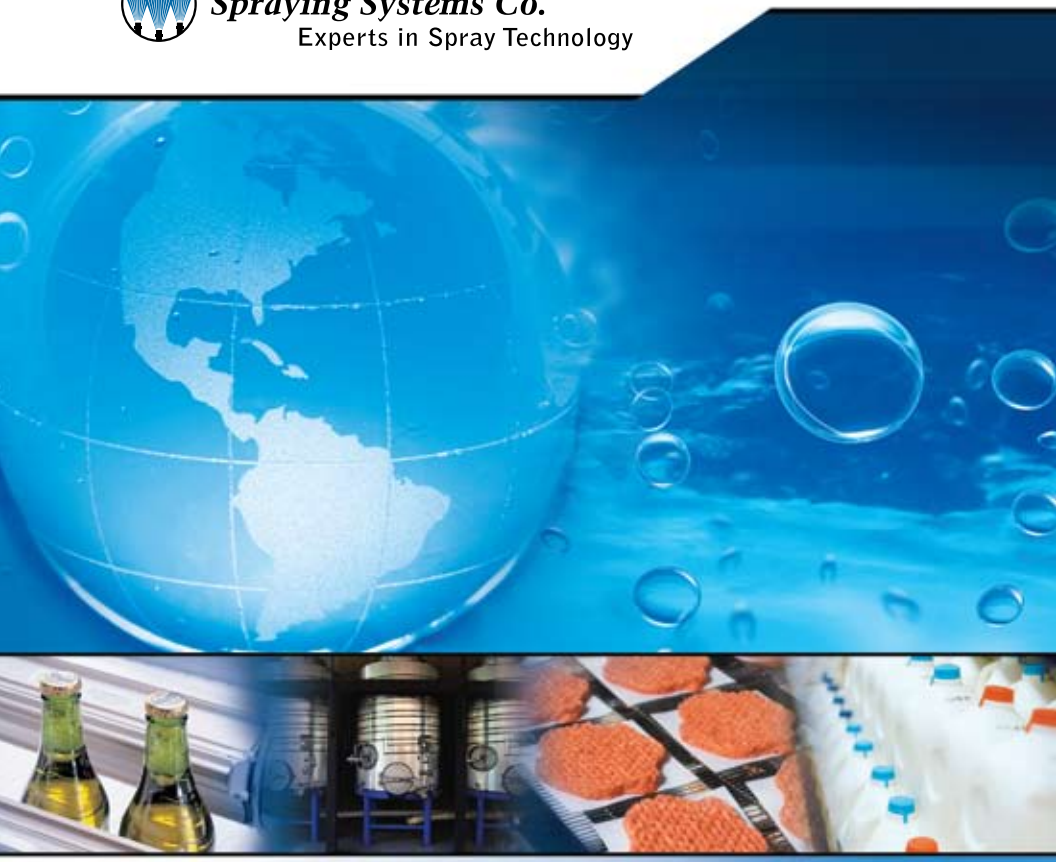
Spraying Systems Co.®
Experts in Spray Technology



Change the Way You Spray to Maximize Water Conservation

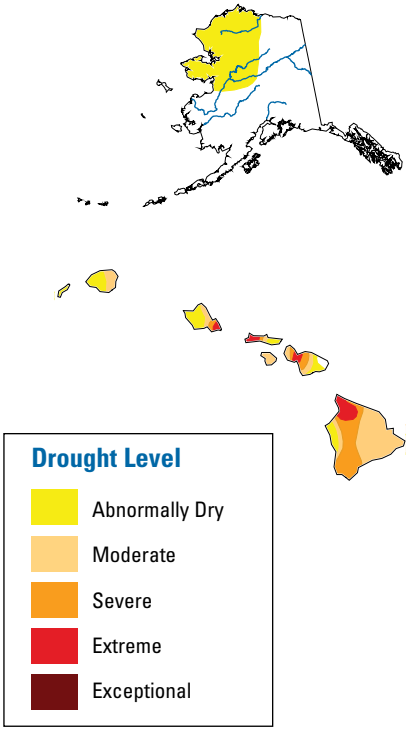
Spray Nozzles | Spray Control | Spray Analysis | Spray Fabrication

Water: An Increasingly Precious Commodity

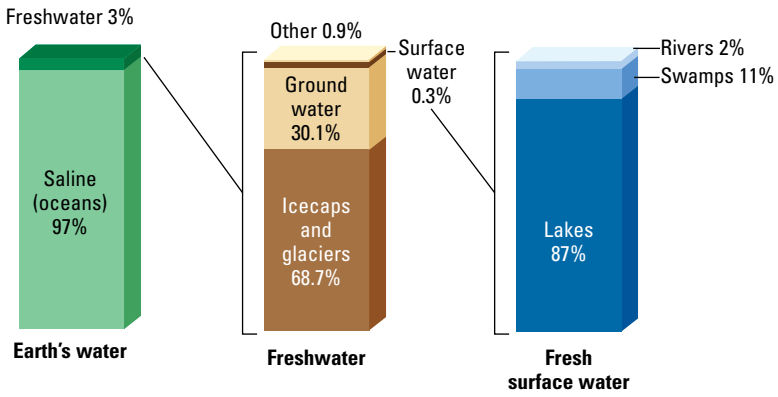
There are many reasons why water is frequently referred to as "the new oil." About 71% of the earth's surface is covered with water, but that doesn't mean this unique, life-sustaining substance is in abundant supply.

The U.S., Canada and Western Europe have more freshwater than most regions. However, these areas are also the greatest consumers of freshwater. The U.S. at 494,000 gallons (1,870 cubic meters) per year or 100 gallons (.38 cubic meters) per day per capita, tops the list, with Canada second at 388,300 gallons (1,470 cubic meters) per year.

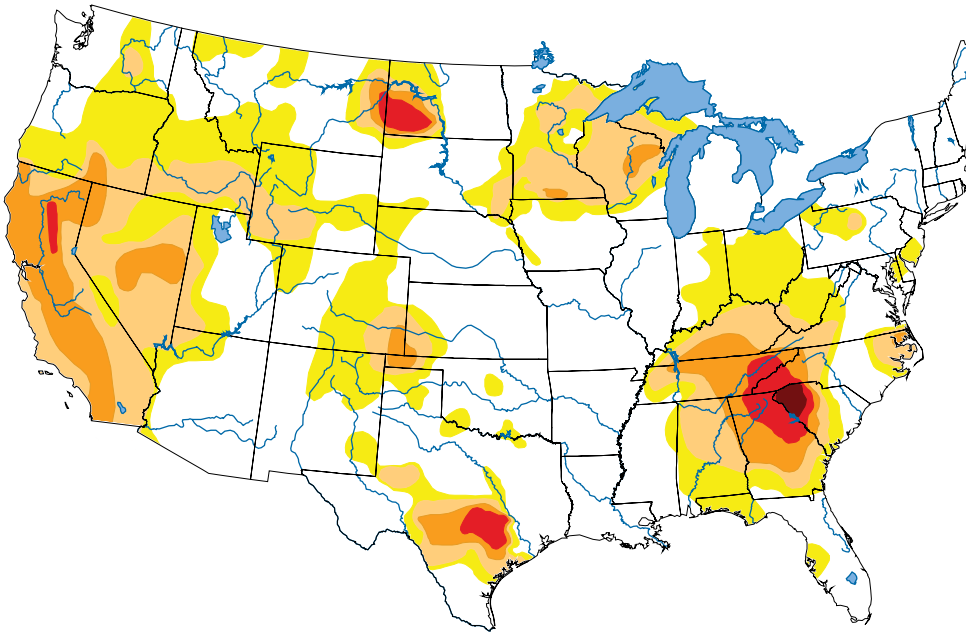
In the U.S., several large areas in the Southeast, Southwest and West are characterized as suffering severe, extreme or – worst case – exceptional drought conditions.



Distribution of Earth's Water



Drought Levels in the U.S.



Water Facts

Water covers approximately 71% of the earth's surface.

97%+ of all water is saline.

Of the roughly 3% that comprises freshwater, most is not readily accessible. According to the U.S. Agency for International Development, if the world's water supply is compared to one gallon (3.8 liter), freshwater would make up 4 ounces (0.118 liter) and readily accessible freshwater would make up a mere two drops.

Lake Baikal in southern Siberia and the Great Lakes contain about 20% of the world's freshwater.

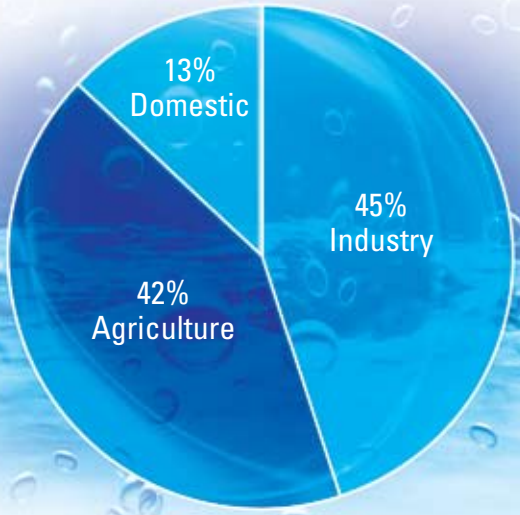
The entire continent of Asia has only 36% of global freshwater runoff.

Today, 1/3 of the world's population faces water scarcity, with this number estimated to reach 4 billion by 2050.

Water: An Increasingly Precious Commodity

Water Conservation as a Sustainability Program

In the U.S., 45% of freshwater use is by industry, 42% by agriculture and 13% for domestic purposes. The cost of infrastructure improvements and replacement has not yet been built into U.S. water costs, so rates remain relatively low compared to other regions of the world.



In the last year:

- **The average cost of water has risen 7.3%**
- **Since 2003, the average water cost has increased nearly 30%**
- **The cost per 1000 gallons (3.8 kiloliters) including sewer charges ranges from $3.00 to $7.00 USD**

The rising costs have caused industry to take a hard look at water use and helped focus attention on conservation. Recycling of water now enables approximately 17 uses in production processes before discharge, compared to the one or two uses of just a few decades ago.

The Sustainability Imperative

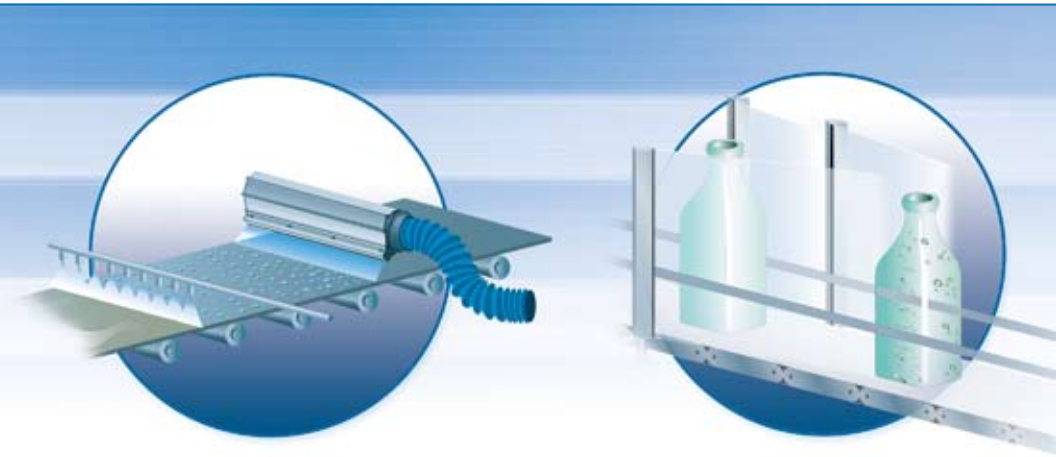
Sustainability is defined in numerous ways but perhaps the most simplistic is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Most experts agree that to ensure the world has enough safe water in the future, we must act aggressively now. Water conservation is becoming an imperative rather than an option.

The food processing, dairy and beverage industries, in particular, are working diligently to increase awareness of the importance of water conservation and providing recommendations on conservation techniques. Food processing is one of the largest manufacturing sectors and is water-use intensive. Water is used as an ingredient, in cleaning, in heat transfer and in plant and equipment sanitation. Industry estimates indicate that .26 gallon (1 liter) of water is required to produce one calorie consumed as food. So, to produce a 500-calorie food item, approximately 130 gallons (492 liters) of water are used.

Many organizations are providing educational information to help food processors conserve water. To support and advance that effort, we've compiled some of those guidelines here and developed more specific suggestions to help improve the efficiency of various spray operations and reduce water consumption.

Ways to Conserve Water

- ☐ Fix leaks! As simple as this sounds, it is often overlooked. Some processors have reported a 14% reduction in water consumption simply by fixing leaks. Sub-meters can be installed to detect leaks
- ☐ Replace pipes with drilled holes with spray manifolds. Pipes with holes use excessive amounts of water
- ☐ Be sure the proper nozzles are being used for the application. Using the wrong spray pattern or nozzles that produce drops that are too large or too small, can cause overspray, overwetting or misting
- ☐ Be sure nozzles are properly positioned to ensure precise spray coverage with minimal waste
- ☐ Install high-pressure, low-volume nozzles on spray washers
- ☐ Use fogging nozzles to cool product
- ☐ Use air to rinse bottles and cans
- ☐ Install in-line strainers on all spray headers; inspect nozzles regularly for clogging and wear
- ☐ Establish optimum depth of product on conveyors and use nozzles that offer accuracy and precision to maximize efficiency and minimize waste
- ☐ Determine whether discharges from any operation can be substituted for freshwater supplied to another operation
- ☐ Use reclaimed water for flushing floor gutters



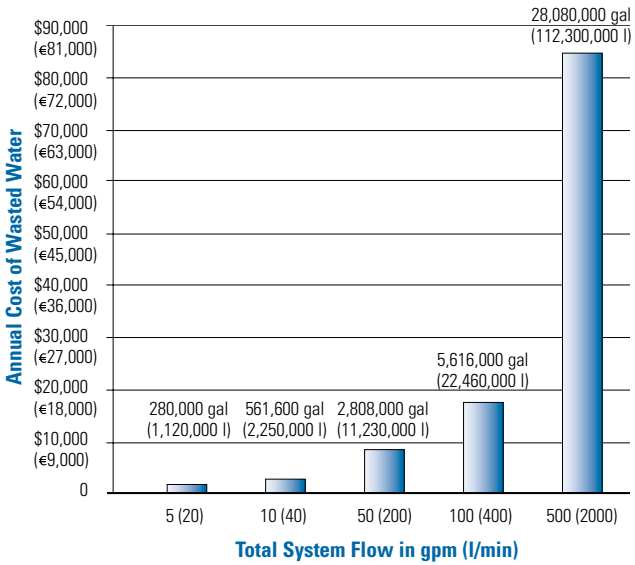
- ☐ Divide the spray wash units into two or more sections and establish a counter flow re-use system
- ☐ Add handheld spray guns to open hoses to ensure water is "on" only when needed
- ☐ As spray equipment wears out, replace with water-saving models
- ☐ Equip all hoses with spring loaded shutoff nozzles and ensure they aren't removed
- ☐ Use check valves with nozzles to prevent drips and leaks and to maintain line pressure
- ☐ Instruct workers to use hoses – equipped with spray guns – sparingly and only when necessary
- ☐ Adjust flows from recirculation systems by controlling the rate of makeup water
- ☐ Close filling lines when not in operation
- ☐ Turn off all flows during shut downs (unless flows are essential for clean-up). Use solenoid valves to stop the flow of water when production stops
- ☐ Adjust flows in sprays and other lines to meet the minimum requirements
- ☐ Control belt sprays with a timer to allow for the intermittent application of chlorinated water

Proactively Seek Out Waste

Nozzle Wear – a Leading Cause of Water Waste

One often undetected source of water waste is nozzle wear. Wear is not usually noticeable in the early stages. As wear progresses, the signs become visible and costly. Operating costs will rise and product loss may occur. Monitoring nozzles closely and taking the appropriate action can save thousands of gallons of water per day.

Start by comparing the measured consumption of spray devices to the manufacturer's performance data. As a nozzle wears the orifice becomes larger and, at any given pressure, flow increases. Then, calculate the total amount of lost water for each nozzle due to wear. Even slight nozzle wear can be extremely wasteful.



Based on a five day work week, 24 hours per day, assuming 15% waste rate. Water/sewage cost: $0.003 (€0.0027) per gal $0.00079 (€0.00071) per l

Other signs of nozzle wear may be visible. As drop size increases or erosion and corrosion occur, spray patterns may change.

Some processors elect to change out spray nozzles annually. Depending on the number and type of spray operations, the cost of replacement nozzles can be far less than the cost of wasted water even if the nozzles are only 15 to 20% worn.

Evaluate Nozzle Type and Material

You may find that changing nozzle type or nozzle material may minimize waste and wear especially if spraying solutions with abrasives or sugar slurries. Nozzles made from harder materials generally provide longer wear life. In addition to standard materials such as brass, stainless steel and many plastic materials, spray nozzles can also be supplied in other materials upon special request. The chart below provides standard abrasion resistance ratios for many of these materials to help you determine if you should consider a change.

Materials that offer better corrosion resistance are also available. However, the rate of chemical corrosion on specific nozzle materials is dependent on the corrosive properties of the liquid being sprayed, its percent concentration and temperature, the corrosion resistance of the nozzle material to the specific chemical, the environment air and temperature. Be sure to discuss these issues with your spray nozzle supplier to select the best material for your applications.

Approximate Abrasion Resistance Ratios

Spray Nozzle Material	Resistance Ratio
Aluminum	1
Brass	1
Polypropylene	1 - 2
Steel	1.5 - 2
MONEL®	2 - 3
Stainless Steel	4 - 6
HASTELLOY®	4 - 6
Hardened Stainless Steel	10 - 15
Stellite®	10 - 15
Silicon Carbide (Nitride Bonded)	90 - 130
Ceramics	90 - 200
Carbides	180 - 250
Synthetic ruby or sapphire	600 - 2000

Proactively Seek Out Waste

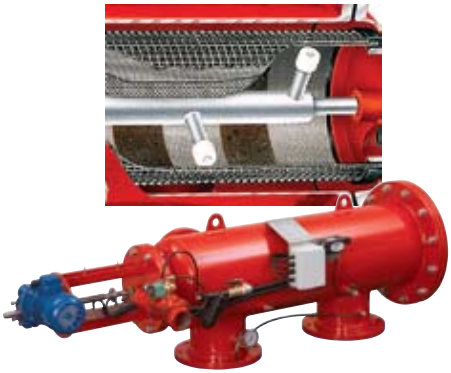
Explore Reducing Spray Pressure

Although it is not always possible, decreasing pressure, which will slow the liquid velocity through the orifice, may help reduce the orifice wear/corrosion rate. Reducing pressure and flow can also help reduce moisture in the air that can contribute to bacteria growth and/or distribution.

Add Line Strainers or Change to Nozzles with Built-in Strainers

In many applications, orifice deterioration and clogging are caused by solid dirt particles in the sprayed liquid. This is particularly common in systems using continuous spray water recirculation. Strainers, or nozzles with built-in strainers, can trap larger particles and prevent debris from entering the nozzle orifice or vane to significantly reduce wear. In higher flow applications, automatic self-cleaning strainers with large filter areas capture most contaminants and flush them away without interrupting the process using minimal water.

Integral strainers keep debris from entering nozzle.



One type of self-cleaning strainer uses a suction scanner, a hollow stainless steel pipe with tubular nozzles evenly spaced along its length. The spiraling motion of the nozzles cleans 100% of the strainer screen.

Consider Automation

Most food processors have tanks, vats and vessels to clean. Often, these are cleaned manually by workers equipped with hoses. Tanks are also often cleaned by filling them with a cleaning solution, draining and then refilling for rinsing. Depending on the tank size, these cleaning methods can use hundreds of gallons (liters) of water every time the tank is cleaned.

Automated tank cleaning systems are an effective alternative and can reduce water consumption by 20% or more. Clean-in-place systems use spray nozzles to provide controlled, thorough cleaning and rinsing. High-impact motorized tank washers and automated turnkey systems are other options. In addition to using considerably less water than manual and fill/drain methods, automated tank cleaning offers many benefits:

- Faster cleaning
- More thorough cleaning
- Reduced use of costly chemicals
- Reduced disposal costs
- Improved worker safety
- Reduced labor costs and maintenance downtime

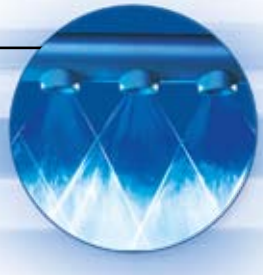
Workers are also often dispatched to clean equipment using portable sprayers. Again, manual application of the cleaning solution is usually wasteful. Using an automated spray system consisting of a spray controller, nozzles and pumps will reduce water and chemical use, provide more consistent cleaning and free workers for other tasks.

Dozens of Ways to Conserve Water

As just reviewed, there are many steps you can take to reduce water consumption. Here are just a few examples of actions taken by food processors and the significant results.

CASE STUDY 1:

Conveyor Spray Rinse System with Five Headers



- Each header has 12 nozzles; rated at 1.0 gpm at 40 psi (3.7 l/min at 2.8 bar)
- Header pressure: 60 psi (4.1 bar)
- System is in use 20 hours per day, five days per week, 51 weeks per year
- Nozzles are worn to 15% increase in capacity which results in:
  - Increased capacity for the five headers from 72 to 82.8 gpm (273 to 314 l/min)
  - Total increased capacity for five headers: 10.8 gpm (40.8 l/min)
  - Increased water consumption of 3,304,800 gallons (12,510 kiloliters) per year
  - Annualized increased water/disposal costs based on $7.00 USD/1,000 gallons: $23,134 USD

Nozzle wear can be detected through an ongoing maintenance program and/or nozzle testing by a spray nozzle manufacturer. Once wear rates have been determined based on hours of use, nozzles can be replaced at regular intervals to minimize water waste.

In this instance, excess water consumption of more than 3,300,000 gallons (12,500 kiloliters) can be avoided if nozzles are replaced as soon as wear is detected.

CASE STUDY 2:

Plant Reduces Consumption of Hot Water by More Than 4,000,000 Gallons (15,142 Kiloliters) Per Year

A chemical processing plant was using 276 gallons (1,044.7 liters) of 150°F (65.6°C) water to clean an average size, 400 gallon (1,514 liter) tote. More than 30,000 totes per year were being cleaned and each cleaning cycle was 30 minutes.

The processor realized the cleaning system was cost-prohibitive and sought help. A new system was designed around a motorized tank washer. It not only uses less water, the new system provides better cleaning in less time. Each tote is now cleaned with 129 gallons (488 liters) for an annual savings of 4,410,000 gallons (16,694 kiloliters) of hot water per year. In addition, cleaning cycles are now just 10 minutes per tote, allowing the totes to be returned to service more quickly.

The estimated annual cost savings for the water consumption reduction is $28,000 USD.

Dozens of Ways to Conserve Water

CASE STUDY 3:

Brewery Saves 5,000,000 Gallons (18,927 Kiloliters) of Water Annually

One of the key components in beer brewing is the hot wort receiver. Fast and efficient cleaning of the hot wort receiver is critical for sanitation and maintaining the number of brews per day.

A single brewery often uses 10,000,000 gallons (37,854 kiloliters) of hot water annually to clean hot wort receivers. One U.S. brewery found that unacceptable and asked for help.

The solution is an optimized motor-driven tank washer equipped with flush nozzles. The results are dramatic, with 15,000 gallons (56,781 liters) of water saved per day.

The annual savings is 5,100,000 gallons (19,306 kiloliters) based on 340 brewing days per year.

CASE STUDY 4:

Turkey Processing Plant Cuts Daily Water Consumption by Replacing Open Hoses with Spray Guns

A turkey processing plant was using 15 open-end sanitation hoses. The hoses were in use eight hours per day, five days per week, 50 weeks per year. Daily consumption of hot water for sanitation was 500,000 gallons (1,892 kiloliters). Hot water shortages compelled this processor to ask for alternate approaches to sanitation.

We suggested replacing the open-end hoses with hoses equipped with spray guns to decrease water consumption by 30% per hose. The processor knew this would be a challenge since sanitation crews preferred to use open-end hoses. However, since the potential water savings was so significant, the processor decided to commit to a training program to ensure the spray guns were used.

The results have been worth the effort:

- Capacity per hose has decreased from 156 to 120 gpm (590 to 454 l/min)
- Total water consumption decrease for the 15 hoses is 36 gpm (136 l/min)
- Water consumption decrease per day is 17,280 gallons (65,411 liters)

Annualized decrease in water/disposal costs based on $7.00 USD/1,000 gallons: $30,240 USD.

CASE STUDY 5:

Meat Processing Plant Learns How to Save Almost 57,000 Gallons (216 Kiloliters) Per Hour of Operation

This meat processor in the Midwest region of the U.S. called for some expert advice on how to conserve water from its spray nozzle manufacturer. Technical representatives were dispatched to the plant to review operations and provide water conservation suggestions. Here is a sampling of the findings:

Chill Area
Visual inspection showed adequate sprays with good coverage.

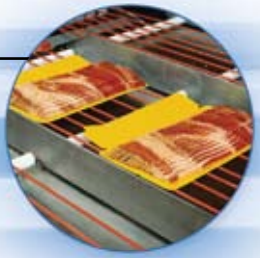
Suggestion: Continued use of the same nozzles and cleaning at three-month intervals. Wear testing in the manufacturer's test labs was suggested to determine the exact wear rate and replacement frequency.

Wash Cabinets
One solenoid valve in a washing unit was malfunctioning, causing water to spray when not required. The washer had a mixture of 38 various nozzles, including 10 bathroom shower nozzles that were delivering poor coverage.

Suggestion: Replace the shower nozzles with 30° full cone nozzles, for a savings of 2.5 gpm (9.5 l/min). Replacing the defective solenoid valve to save another 0.437 gallon (1.6 liters) for every minute water flow is shut down.

On a second unit, bathroom shower nozzles were providing poor coverage. Eight misting nozzles, not designed for washing applications, were also in use.

Suggestion: Replace the bathroom shower nozzles with a different type of nozzle to improve coverage and operate at a lower flow rate. Replace the misting nozzles with high-pressure/high-impact wash nozzles. Total water savings: 2.65 gpm (10 l/min).



Hose Drops and Hose Stations
Two of the five spray guns in the skinning room were leaking and had been for quite some time.

Suggestion: Upgrade to a higher quality gun with a variable spray pattern that allows the operator to optimize the gun's performance depending on the task.

Whiphouser and Head Polisher Manifolds
Holes, drilled in pipe on 4 to 6" centers, were being used without nozzles. Some holes were 1/4" in diameter to accommodate contaminates in the fluid and coverage was poor.

Suggestion: For improved coverage at half the flow rate, plug every-other hole in all the pipes and install flat spray nozzles in the others. Water savings: 202.4 gpm (766.2 l/min) per manifold.

Gam table
It wasn't clear from a visual inspection that the spray nozzles in use were worn. Spray testing determined that the nozzles were 209% over capacity.

Suggestion: Replace worn nozzles for a water savings of 2.4 gpm (9.1 l/min) over specification.

Manifold
Manifolds continued spraying when the conveyors were shut down.

Suggestion: Add solenoid valves, tied into the conveyor movement, to shut down the manifolds when the conveyor is not moving. Savings of 5.5 gallons (20.8 liters) per manifold for every minute not in use.

In total, more than 40 areas of the plant were evaluated. The suggested changes have the potential to save 947.7 gpm (3,587.4 l/min). That's 56,862 gallons (215.2 kiloliters) of water for every hour the plant operates.

Dozens of Ways to Conserve Water

CASE STUDY 6:

Dairy Reduces Water Consumption by $400,000 USD Annually

With astonishing speed, tens of thousands of gallons of conserved water can become millions. One dairy in Minnesota has saved more than $400,000 per year over the past decade while avoiding an assessment of $200,000 that otherwise would have been levied by the public wastewater treatment facility.

Many dairies use more than 4 gallons (15 liters) of water to process each gallon of milk and with some effort this can be reduced dramatically. Here's how this dairy reduced its water consumption by 13,000,000 gallons (49,210 kiloliters) of water annually.

- Repairing leaky connections and valves saved 4,860 gallons (18.4 kiloliters) per day
- Adding a valve to the spray bar on the returnable carton cleaning line to provide intermittent operation saved 2,400 gallons (9.1 kiloliters) per day
- To wash spilled milk off the fill line, a spray nozzle operated continuously. Changing to a "trigger-only" when a carton got stuck saved 7,000 gallons (26.5 kiloliters) per day
- Changing shower heads and spray bars to smaller nozzles and mist sprays saved another 5,340 gallons (20.2 kiloliters) per day

How Your Spray Systems Can Contribute to a Sustainable Future

Spray nozzles are precision components designed to yield very specific performance under very specific conditions. Just because a nozzle is spraying doesn't mean that the nozzle is working properly.

When your spray system isn't performing to specification, you're not only depleting a valuable resource, you may experience many other costly problems such as:

- Quality control issues
- Unscheduled production downtime
- Increased maintenance
- Increased consumption of costly chemicals, water and electricity

The resulting cost of these problems can be surprising and, in some cases, staggering. As we've seen here, the cost of wasted water alone can reach tens of thousands of dollars a year in a system with a relatively minor deterioration in performance. To ensure that your system is operating at peak efficiency, begin with an audit of your spray system. Help is readily available and involving an expert at the beginning of the process will save time and money.

We hope this information is helpful and motivates you to begin or advance your water conservation efforts. Should you need assistance or have questions, please contact us.

Other Helpful Resources

Optimizing Your Spray System
Technical Manual 410

52-page handbook/manual explains how to evaluate your spray system, uncover and solve costly hidden problems, improve quality, reduce maintenance downtime and more.

Industrial Spray Products
Catalog 70

Full-line catalog including spray nozzles and accessories, technical data and problem solving ideas.

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