



# How to Reduce Water Consumption in Cleaning, Cooling and Moisturizing Operations

By Jon Barber, Spraying Systems Co.

In the U.S., industry uses 45% of freshwater annually. The heaviest users of water include the food, chemical, petrochemical, primary metal and paper industries.

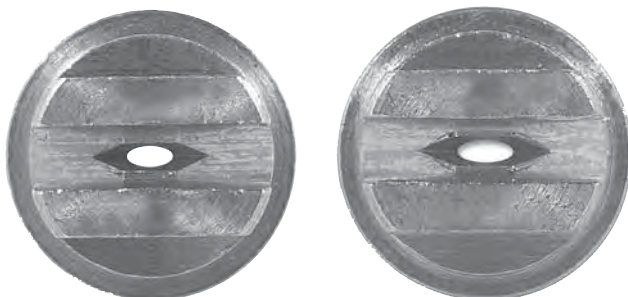
In the last ten years, water costs have more than doubled in some areas causing all manufacturers and processors to take a hard look at water costs. When waste water disposal costs are included, it is a significant expense. The average cost per 1000 gallons (3,785.4 liters) is approximately \$7.00 USD, including sewer charges.

## Nozzle Wear Means Water Waste

Spray nozzles are at the heart of many operations that utilize water in most plants. These seemingly simple components have a significant impact on performance and operating costs in cleaning, sanitizing, cooling, moisturizing and dozens of other applications.

As spray nozzles wear, their orifices become larger and the flow rate will increase. Even slight nozzle wear that can't be detected visually can be extremely wasteful, costing tens – sometimes hundreds – of thousands of dollars annually in increased operating expenses.

Worn nozzles that spray over capacity are wasting more than water. Electricity costs due to excess pump operation, chemical consumption and waste water disposal costs will all increase as well. Figure 1 illustrates just two examples of how quickly costs can rise.



Nozzles that are worn as much as 30% (right) show no visible signs of wear.

FIGURE 1.

### Example 1: Conveyor Rinse System with Five Headers

#### Increased Operating Expenses (USD)

Each header has 12 nozzles, rated at 1.0 gpm at 40 psi (3.7 l/min at 2.8 bar). Header pressure is 60 psi (4.1 bar). System is in use 100 hours per week, 51 weeks per year. Nozzles are worn to 15% over the rated capacity.

- Increased capacity for the five headers from 72.0 to 82.8 gpm (273 to 314 l/min)
- Total increased capacity for the five headers is 10.8 gpm (40.8 l/min)
- Increased water consumption of 3,304,800 gallons (12,510 kiloliters) per year
- \$23,134 USD increase in water/disposal costs

### Example 2: Cleaning Headers

#### Increased Operating Expenses (USD)

One header with 72 nozzles, rated at 2.34 gpm at 350 psi (8.8 l/min at 24.1 bar). Header pressure is 40 psi (2.8 bar). System is in use 60 hours per week, 48 weeks per year. Nozzles are worn to 15% over the rated capacity.

- Increased capacity for the header from 168.5 to 193.8 gpm (637.8 to 733.4 l/min)
- Increased water consumption of 4,367,002 gallons (16,531 kiloliters) per year
- \$65,156 increase in water/electricity costs

If you have ten headers, the amount wasted quickly becomes over **half a million dollars** annually.

# Ways to Reduce Water Consumption

## #1: Replace worn spray nozzles on a regular schedule

Worn spray nozzles are a common problem in many plants often due to the liquid being sprayed. Abrasive or corrosive materials can compromise nozzle performance and speed the replacement cycle. 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.

### Spray Nozzle Maintenance Checklist

#### Flow Rate – Each Nozzle

Centrifugal Pumps: Monitor flow meter readings to detect increases. Or collect and measure the spray from the nozzle for a given period of time at a specific pressure. Then compare these readings to the flow rates listed in the manufacturer's catalog or compare them to flow rate readings from new, unused nozzles.

Positive Displacement Pumps: Monitor the liquid line pressure for decreases; the flow rate will remain constant.

#### Spray Pressure – In Nozzle Manifold

Centrifugal Pumps: Monitor for increases in liquid volume sprayed. (Spraying pressure likely to remain the same.)

Positive Displacement Pumps: Monitor pressure gauge for decreases in pressure and reduction in impact on sprayed surfaces. (Liquid volume sprayed likely to remain the same.) Also, monitor for increases in pressure due to clogged nozzles. Visually inspect for changes in spray coverage.

#### Drop Size

Examine application results for changes. Drop size increases cannot be visually detected in most applications. An increase in flow rate or a decrease in spraying pressure will impact drop size.

#### Spray Pattern

Visually inspect each nozzle for changes in the uniformity of the pattern. Check spray angle with protractor. Measure width of spray pattern on sprayed surface.

Based on the results of your monitoring, you may need to replace your nozzles to prevent waste. A reputable nozzle manufacturer can help you develop a proactive nozzle replacement plan to optimize your system's performance.

## #2: Change nozzle material to extend wear life and ensure optimal performance

Nozzles made from harder materials generally provide longer wear life. In addition to standard materials such as brass and stainless steel, more durable spray nozzles are often available in specialty materials, carbides or with ruby orifices.

Figure 2 provides standard abrasion resistance ratios for many of these materials to help you determine if you should consider a change.

FIGURE 2.

### 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

## #3: Reduce spray pressure if performance won't be compromised

Although it is not always possible, decreasing pressure, which will slow the liquid velocity through the orifice, may help reduce the rate at which the orifice wears.

# Ways to Reduce Water Consumption

## #4: Use self-cleaning nozzles or strainers to protect nozzles and minimize wear

In many applications, orifice deterioration and clogging are caused by solid particles in the sprayed liquid. This is particularly common in systems using continuous spray water recirculation. In an average production process, recycling of water enables approximately 17 uses before discharge, as opposed to one or two uses without recirculation.



Clean-out needles remove debris from nozzle orifices.

Self-cleaning nozzles are available in a number of configurations and operating styles. For example, nozzles with clean-out needles are ideal for intermittent spraying applications using liquid that can dry in the orifice between uses. The clean-out needle can be activated manually or automatically, depending on nozzle type, and slides through the liquid orifice to clear obstructions. Automatic spray nozzles can be equipped with a clean-out needle that cleans the liquid orifice after each spray cycle for maximum protection against clogging.

Other self-cleaning nozzles retract a purge piston when line pressure is reduced to remove fibers and other solids from a clogged nozzle. Spray headers, with internal brushes that rotate and remove debris from nozzle orifices, are also widely used in applications where less than pristine water is used.

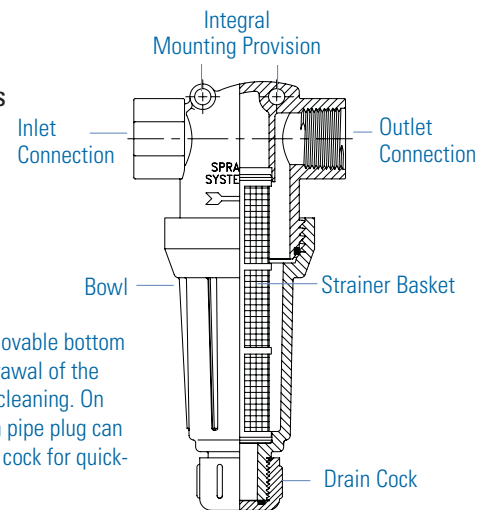
Strainers, or nozzles with built-in strainers, trap larger particles and prevent debris from entering the nozzle orifice or vane to significantly reduce wear.

Integral strainers can often be ordered as part of the nozzle itself and are available in a variety of mesh sizes, down to 200 mesh, and materials including brass, aluminum, nylon, stainless steel and polypropylene, for standard and quick-connect flat spray, full cone, hollow cone and fine spray nozzles.



Integral strainers keep debris from entering nozzle.

T-strainers are widely used and available in many configurations. Most are designed to minimize pressure drop and provide simple/fast cleaning and maintenance. Self-cleaning versions, which allow the filtered liquid to pass through the strainer and liquid particles to be returned to the liquid supply, are another option. Strainers are available in a wide variety of materials – including FDA-compliant materials for potable water usage – for low-, medium- and high-pressure applications.



T-strainers feature a removable bottom plug for complete withdrawal of the screen assembly during cleaning. On some models the bottom pipe plug can be replaced with a drain cock for quick-flush cleaning.

## #5: Use spray guns instead of open hoses

For clean-up throughout the plant, use low-pressure spray guns instead of open hoses. Water consumption can be reduced by 50% or more using spray guns. Ensuring water is “on” only when needed significantly reduces waste.



Using spray guns instead of open hoses can reduce water consumption by as much as 50%.

# Ways to Reduce Water Consumption

## #6: Automate tank cleaning

Tanks are often cleaned manually by workers equipped with hoses or by filling and draining the tank multiple times. 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 to manual cleaning. Some plants have reported saving up to \$50,000 USD per year per tank by switching to automated cleaning.

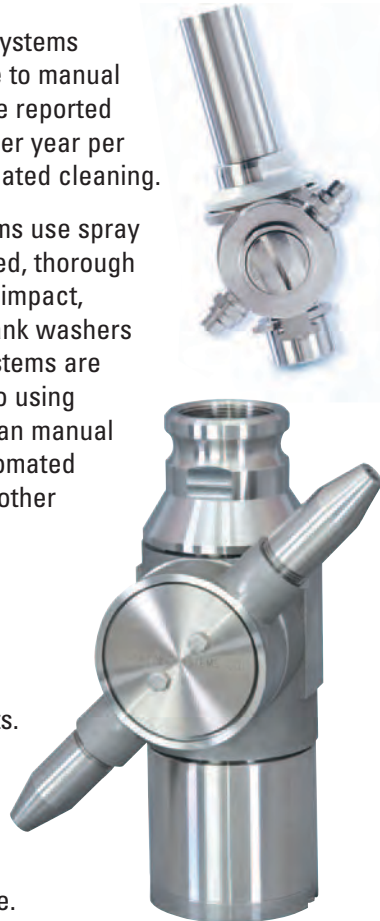
Clean-in-place (CIP) systems use spray nozzles to provide controlled, thorough cleaning and rinsing. High-impact, fluid-driven or motorized tank washers and automated turnkey systems are other options. In addition to using considerably less water than manual and fill/drain methods, automated tank cleaning offers many other benefits.

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

Turnkey systems integrate pumps, sensors, motors and valves designed to optimize the performance of tank cleaning nozzles.

Systems can be equipped to recirculate cleaning liquid in a closed loop, allowing the reuse of a portion or all water and chemical cleaning solutions.

As with all spray systems, it's important to monitor system performance and water usage over time. Ongoing evaluation of automated systems may reveal opportunities for optimization and additional savings.



Motorized and fluid-driven tank washers provide high-impact cleaning and reduce water/chemical use and labor costs.

## #7: More ways to save water

- Fix leaks! As simple as it sounds, it is often overlooked. Some plants have reported a 14% reduction in water consumption simply by fixing leaks. Sub-meters can be installed to detect leaks.
- Replace pipes that use drilled holes to create spray patterns. An engineered manifold will improve spray performance and will save enough water to pay for itself.
- 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.
- Determine whether discharges from any operation can be substituted for freshwater supplied to another operation.
- Use reclaimed water for flushing floor gutters.
- 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.
- Close filling lines when not in operation and consider using flow restrictors in liquid lines.
- 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.

# Ways to Reduce Water Consumption

## Optimized spray systems contribute to a sustainable and profitable future

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

When your spray systems aren't optimized, 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 and electricity.

To ensure your system is operating at peak efficiency and not wasting water, begin with an audit of your spray system by a reputable nozzle manufacturer. An audit is typically offered at no cost and may require several hours of work.

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.

We hope you found this white paper helpful and that you will take any additional steps required to minimize unnecessary water use. To consult with one of our experts, call 1.800.95.SPRAY.

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