WaterSense at Work

Laboratory and Medical Equipment

7.4 Glassware Washers

Best Management Practices for Commercial and Institutional Facilities

EPA WaterSense

March 2024

WaterSense® is a voluntary partnership program sponsored by the U.S. Environmental Protection Agency (EPA) that seeks to protect the nation's water supply by transforming the market for water-efficient products, services, and practices.

WaterSense at Work is a compilation of water efficiency best management practices intended to help commercial and institutional facility owners and managers from multiple sectors understand and better manage their water use. It provides guidance to help establish an effective facility water management program and identify projects and practices that can reduce facility water use.

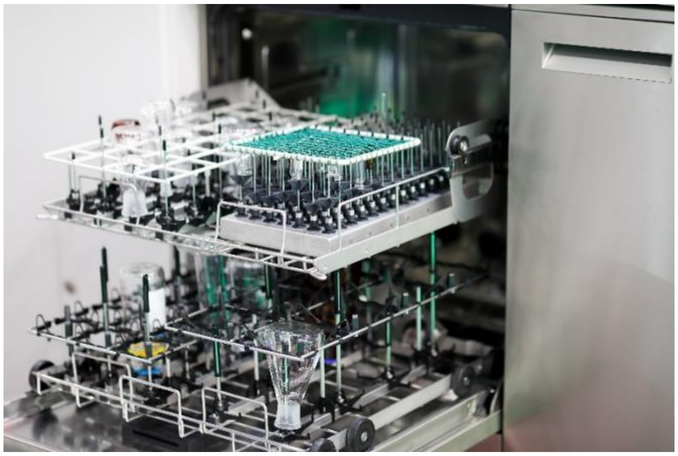
An overview of the sections in *WaterSense at Work* is below. This document, covering water efficiency for glassware washers, is part of **Section 7: Laboratory and Medical Equipment**. The complete list of best management practices is available at www.epa.gov/watersense/best-management-practices. WaterSense has also developed worksheets to assist with water management planning and case studies that highlight successful water efficiency efforts of building owners and facility managers throughout the country, available at www.epa.gov/watersense/commercial-buildings.

- **Section 1. Getting Started With Water Management**
- **Section 2. Water Use Monitoring**
- **Section 3. Sanitary Fixtures and Equipment**
- **Section 4. Commercial Kitchen Equipment**
- **Section 5. Outdoor Water Use**
- **Section 6. Mechanical Systems**
- **Section 7. Laboratory and Medical Equipment**
- **Section 8. Onsite Alternative Water Sources**

EPA 832-F-23-003
Office of Water
U.S. Environmental Protection Agency
March 2024

This document is one section from *WaterSense at Work: Best Management Practices for Commercial and Institutional Facilities* (EPA-832-F-23-003). Other sections can be downloaded from www.epa.gov/watersense/best-management-practices. Sections will be reviewed and periodically updated to reflect new information. The work was supported under contract 68HERC20D0026 with Eastern Research Group, Inc. (ERG).

Overview



Laboratory glassware washer

Glassware washers are automated washing devices that remove chemical or other particle buildup on laboratory glassware, such as pipettes, flasks, and graduated cylinders. Glassware washers are often supplied with both potable and purified water (e.g., deionized [DI] water or reverse osmosis [RO] permeate). Purified water is typically used in the final rinse stages to ensure that no contaminants are left on glassware surfaces. Potable water used during other wash or rinse stages may or may not be treated with a water softener to reduce water hardness, which can cause scale buildup or mineral accumulation on glassware. Similar to steam sterilizers (discussed in more detail in *WaterSense at Work Section 7.3: Steam Sterilizers* at www.epa.gov/watersense/best-management-practices), some glassware washers that operate at high temperatures may require additional potable water to cool hot water discharge to 140°F (60°C) or less.

Glassware washers are a more water-efficient method of washing when compared to hand washing and rinsing of laboratory glassware. In fact, it can take about 20 gallons (76 liters) of water to hand wash 30 pieces of labware, while using an efficient glassware washer uses 13 gallons (49 liters) or less.[1]

Newer, more efficient glassware washers use flow control and sensing capabilities to reduce water use for each wash and rinse cycle. Some also offer flexible programming, allowing the user to select the number of rinse cycles needed to achieve the desired level of cleanliness. Glassware washers that allow users to choose the number of rinse cycles or otherwise customize the washing and rinsing process can help reduce water use. In addition to selecting models with these water-efficient features, lab managers can save water by selecting a glassware washer size appropriate for research needs without oversizing. Because water used in glassware washers is typically heated to high temperatures, using less water will save energy, too.

[1] Henderson, Jordan. September 2020. "Choosing the Right Glassware Washer." www.labconco.com/articles/choosing-the-right-glassware-washer.

Operation, Maintenance, and User Education

For optimum glassware washer efficiency, consider the following operation, maintenance, and user education tips:

- Only run glassware washers when they are full. Fill each glassware washer rack to maximum capacity.
- Operate the glassware washer near or at the minimum flow rate recommended by the manufacturer.
- If the number of rinse cycles can be chosen, select as few rinse cycles as possible, considering the cleanliness requirements of the glassware.

Train Staff for Efficient Use

To reduce the water use and operating costs from glassware washers, ensure staff and researchers are trained on water-efficient washing practices. First, communicate that running full loads of a glassware washer uses less water than hand washing glassware. If the glassware washer allows the user to select the number of rinse cycles, encourage them to select as few rinse cycles as possible, keeping in mind the desired level of cleanliness. Selecting a delayed or scheduled start time can allow glassware washing during off-peak hours, which can reduce energy costs.

Retrofit Options

If appropriate given the intended use of the glassware, consider installing a water recycling system that reuses rinse cycle wastewater as wash water in the next load. Some systems are capable of treating rinse cycle wastewater before reusing it. Consider the level of water quality needed before choosing a recycling option.

Consider other add-ons such as cooling reservoirs or heat recovery systems, which can reduce water and/or energy use. If the glassware washer is discharging water at temperatures higher than 140°F (60°C), cooling reservoirs (e.g., drain tanks) can be used to cool down hot water discharge instead of using potable water for tempering. Heat recovery systems use drain tanks to cool discharge water and recover the discharge's heat by transferring it to incoming water used for the next cleaning cycle, thus reducing energy required for hot water generation.

Replacement Options

When purchasing a new glassware washer or replacing an existing one, consider a glassware washer's size and configuration (e.g., undercounter, free-standing), ensuring it is large enough to accommodate the laboratory's needs while also requiring users to run full loads. Compare similar models based on water and energy use and select the more efficient option. Also, look for the following features:

- Cycle selection that allows users to optimize rinse cycles for both effective and efficient cleaning.
- Reuse of final rinse water as wash water for the next load, if appropriate.
- Water intake monitoring to adjust the amount of water used based on load size.
- Delayed or scheduled start feature that allows the start time to be scheduled during off-peak hours to reduce energy costs.

Laboratory glassware washer

If the glassware washer will operate at temperatures higher than 140°F (60°C), consider glassware washers with a cooling reservoir and/or heat recovery system that eliminates the need for tempering glassware washer discharge and can reduce energy consumption needed for heating water in the next cleaning cycle.

Savings Potential

Water savings can be achieved by replacing an existing glassware washer with a more efficient one. A glassware washer's water use is dependent upon the amount of water used during wash and rinse cycles, as well as the total number of cycles. A replacement glassware washer can use less water per cycle through flow control and allow users to select fewer cycles.

To estimate facility-specific water savings and payback, use the following information.

Current Water Use

To estimate the current water use of a glassware washer, identify the following information and use Equation 1 on the next page:

- Average volume of water used during a full wash process. This might be provided by the product manufacturer through product literature or the manufacturer's website. The water efficiency will be dependent upon the flow rate of each rinse or wash cycle, duration of each cycle, and number of cycles. If the water use from the full wash process is not available from the manufacturer, add up the water use from each cycle to determine the water use from the full wash process.
- Average number of wash processes per day.
- Days of operation per year.

Equation 1. Water Use of Glassware Washer (gallons or liters per year)

= Wash Water Use x Wash Processes per Day x Days of Operation

Where:

- Wash Water Use: Gallons (or liters) per wash
- Wash Processes per Day: Washes per day
- Days of Operation: Days of washer operation per year

Water Use After Replacement

To estimate the water use of a more efficient replacement glassware washer, use Equation 1, substituting the average volume of water used during a full wash process of the replacement glassware washer. Efficient models can use less than 13 gallons (49 liters) during the full wash process.[2] If the number of rinse cycles can be chosen, calculate the maximum potential water savings using the water use corresponding to the fewest average number of rinse cycles needed at the facility.

Water Savings

To calculate the water savings that can be achieved by replacing an existing glassware washer, identify the following information and use Equation 2:

- Current water use as calculated using Equation 1.
- Water use after replacement as calculated using Equation 1.

Equation 2. Water Savings From Glassware Washer Replacement (gallons or liters per year)

= Current Glassware Washer Water Use – Water Use After Glassware Washer Replacement

Where:

- Current Glassware Washer Water Use: Gallons (or liters) per year
- Water Use After Glassware Washer Replacement: Gallons (or liters) per year

[2] *Ibid.*

Energy Savings

Because glassware washers use hot water, a reduction in water use will also result in energy savings. The energy required to heat water can be dependent on the proportion of water used in the glassware washer that is hot, fuel used for water heating (e.g., electricity, natural gas), the efficiency of the water heater, and water heater temperature set points. Since this information is not always readily available, energy savings that can be achieved from replacing existing glassware washers can be estimated using the water savings calculated in Equation 2 and the assumptions presented in Equation 3:

Equation 3. Energy Savings From Glassware Washer Replacement (kWh of electricity or Mcf of natural gas per year)

= Water Savings (gallons or liters per year) x Average Percent of Water That Is Hot x (Energy per Gallon or Liter Heated ÷ Water Heater Efficiency)

Where:

- Water Savings: Gallons (or liters) per year
- Average Percent of Glassware Washer Water That Is Hot: Facility-specific
- Energy per Gallon or Liter Heated [assuming 75°F (24°C) water temperature increase]:
    - 0.183 kilowatt hours (kWh) of electricity per gallon (0.048 kWh per liter); or
    - 0.0006 Mcf (thousand cubic feet) of natural gas per gallon (0.00016 Mcf per liter)
- Water Heater Efficiency (unless otherwise known by the facility):
    - 1.0 for an electric hot water heater; or
    - 0.75 for a natural gas hot water heater

Energy usage and costs can also be reduced by keeping a glassware washer in standby mode when not in use and delaying the start of the wash cycle to during off-peak hours if the glassware washer model has these programming capabilities.[3]

[3] May, Mike. March 2019. "Going Green in Glassware Washing." www.labmanager.com/product-focus/going-green-in-glassware-washing-1230.

Payback

To calculate the simple payback from the water savings associated with replacing an existing glassware washer, consider the equipment and installation cost of the replacement glassware washer, the water and energy savings as calculated using Equation 2 and Equation 3, respectively, and the facility-specific cost of water, wastewater, and energy.

Additional Resources

International Institute for Sustainable Laboratories (I2SL) and U.S. Environmental Protection Agency (EPA). May 2022. *Best Practices Guide: Water Efficiency in Laboratories*. www.epa.gov/system/files/documents/2022-06/ws-I2SL-Laboratory-Water-Efficiency-Guide.pdf.

Lab Manager. *Lab Glassware Washers Resource Guide*. www.labmanager.com/lab-glassware-washer-resource-guide-30393.

This page intentionally left blank.

Disclaimer

EPA

United States Environmental Protection Agency
(4204M)
EPA 832-F-23-003
March 2024
www.epa.gov/watersense
(866) WTR-SENS (987-7367)