WaterSense at Work

Laboratory and Medical Equipment

7.7 Photographic and X-Ray Equipment

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 photographic and x-ray equipment, 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**

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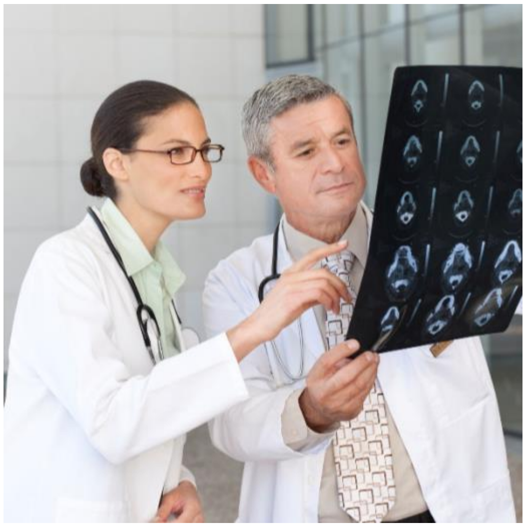
This document is one section from *WaterSense at Work: Best Management Practices for Commercial and Institutional Facilities* (EPA-832-F-23-003). Other sections can be downloaded from www.epa.gov/watersense/best-management-practices. Sections will be reviewed and periodically updated to reflect new information.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

Photographic and X-Ray Equipment

Overview



Due to advances in imaging technology, many laboratory and medical facilities now use digital photographic or X-ray film processing and computerized viewing and printing. Digital imaging has changed the means by which images are recorded and printed and eliminated the use of water entirely. Dry printing processes such as laser and ink-jet printing are other alternatives that do not use water. Digital equipment also eliminates chemical use, improves image quality, improves operational efficiency, and reduces radiation exposure, which improves patient and worker safety.[1,2]

Although most photographic and X-ray equipment is now digital, some facilities still develop film using a traditional process that can be water-intensive. Film is traditionally processed by placing it in various chemical baths to develop and preserve the image. Water is also used to develop and process film and can be used in X-ray processing for equipment cooling. Traditional X-ray film processing machines can require a constant stream of water flowing at a rate of 0.25 to 2.5 gallons per minute (gpm),[3] although some processors will use as much as 3.0 to 4.0 gpm to ensure acceptable image quality.[4] Processors with a flow rate of 0.5 gpm can discharge up to 260,000 gallons of water annually if they operate continuously. To reduce water use, some traditional machines incorporate a water recycling system to treat and reuse the final rinse effluent as make-up for the developer/fixer solution.

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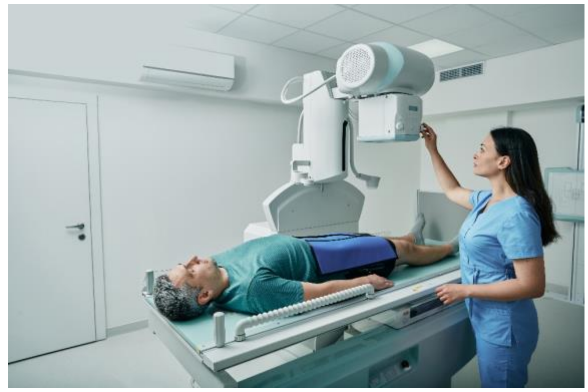
[1] International Institute for Sustainable Laboratories (I2SL) and U.S. Environmental Protection Agency (EPA). May 2022. *Best Practices Guide: Water Efficiency in Laboratories*. www.epa.gov/system/files/documents/2022-06/ws-I2SL-Laboratory-Water-Efficiency-Guide.pdf.

[2] Hutchinson, Chad. June 19, 2023. “Digital X-Rays vs. Traditional X-Rays: What’s the Difference?” Prepared for Patient Image blog. www.patientimage.com/blog/digital-x-rays-vs-traditional-x-rays.

[3] Koeller, John, et al. August 2004. *Evaluation of Potential Best Management Practices—X-Ray Film Processor Recycling Units*. Prepared for the California Urban Water Conservation Council. https://calwep.org/wp-content/uploads/2021/03/X-Ray-Film-PBMP-2004.pdf.

[4] EPA and U.S. Department of Energy (DOE), Energy Efficiency & Renewable Energy (EERE), Federal Energy Management Program (FEMP). May 2005. *Laboratories for the 21st Century: Best Practices, Water Efficiency Guide for Laboratories*. Page 6. https://www.nrel.gov/docs/fy05osti/36743.pdf.

A "mini-lab" is an alternative to the traditional high-rinse process. In these systems, wet chemical solutions are added only as needed for the amount of film being processed, and a reservoir captures spent chemical solutions, which can be recovered and recycled. Mini-labs don't require water for film processing; however, they are for small camera picture prints only—not large frame X-ray films.[5]



Technician initiating X-ray on patient

Although water recycling systems and mini-labs offer less water-intensive solutions for photographic and X-ray film processing, digital imaging is the best option from a water efficiency perspective.

Operation, Maintenance, and User Education

If traditional photographic and X-ray equipment cannot be converted to digital imaging equipment, consider the following tips for optimum efficiency:[6]

- Reduce the flow rate of water to the film processor to the minimum acceptable flow rate specified by the equipment manufacturer. Post minimum flow rates near the processor and educate users on how to adjust and operate the equipment.
- For X-ray equipment, turn off the cooling water flow when the unit is not in use. Check the solenoid valve used to shut off cooling water to ensure it is working properly and stops flow when the equipment is in standby mode or turned off. If necessary, install a flow meter in the supply line to monitor flow from the equipment.

Retrofit Options

To reduce the water use of an existing traditional X-ray system, consider the following retrofits and be sure to follow prescribed maintenance schedules in order to maintain water savings:[7]

- Work with the equipment manufacturer to install a system that recycles the final rinse effluent as make-up for the developer/fixer solution.
- Install a solenoid valve to turn off the flow of water when the unit is not in use.

[5] East Bay Municipal Utility District (EBMUD). 2008. *WaterSmart Guidebook—A Water-Use Efficiency Plan Review Guide for New Businesses*. Pages PHOTO1-8. www.ebmud.com/water/conservation-and-rebates/commercial/watersmart-guidebook.
[6] EPA and DOE, EERE, FEMP, *op. cit*.
[7] *Ibid*.

- On systems that don't require high water pressure, install a device to reduce pressure and keep the water at lower flow rates.

Replacement Options

When looking to replace or purchase new photographic and X-ray equipment, consider the following options:

Radiologist analyzing digital x-ray

- First and foremost, consider digital X-ray and photography equipment and computerized laser or ink-jet printing options.
- If transitioning to digital equipment is not feasible, look for more efficient equipment that reduces water use or reuses water. For example, select equipment that can recycle the final rinse effluent as make-up for the developer/fixer solutions or equipment that removes excess chemicals from the film and requires less water for rinsing.
- If replacing a traditional wet printing, high-rinse flow system in a facility that produces small picture prints, consider a mini-lab system that doesn't use water.

Savings Potential

Replacing traditional X-ray film processing equipment with digital imaging equipment will eliminate water use entirely, but it might not be cost-effective for every facility due to the high cost of the new equipment. Digital equipment, however, provides other advantages in addition to water savings, such as reduced radiation, ease of use, ease of image transfer, and the elimination of physical image storage.

If converting to digital imaging is not feasible, retrofitting existing equipment to recycle the final rinse effluent as make-up for the developer/fixer solution can be a cost-effective option. Based on studies conducted by several water utilities in California, retrofitting traditional X-ray equipment with a recycling system has been shown to save 500,000 to 1,600,000 gallons of water per year per X-ray film processor.[8]

[8] Koeller, *op. cit*.

Additional Resources

East Bay Municipal Utility District. 2008. *WaterSmart Guidebook—A Water-Use Efficiency Plan Review Guide for New Businesses*. Pages PHOTO1-8. www.ebmud.com/water/conservation-and-rebates/commercial/watersmart-guidebook.

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

Koeller, John, et al. August 2004. *Evaluation of Potential Best Management Practices—X-Ray Film Processor Recycling Units*. Prepared for the California Urban Water Conservation Council. https://calwep.org/wp-content/uploads/2021/03/X-Ray-Film-PBMP-2004.pdf.

U.S. Environmental Protection Agency and U.S. Department of Energy (DOE), Energy Efficiency & Renewable Energy, Federal Energy Management Program. May 2005. *Laboratories for the 21st Century: Best Practices, Water Efficiency Guide for Laboratories*. Page 6. https://www.nrel.gov/docs/fy05osti/36743.pdf.

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