WHITE PAPER

How to Reduce Resource Use in Validated Cleaning

Reducing the Environmental Impact of Component Washing in Pharmaceutical Manufacturing

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Abstract

For pharmaceutical manufacturers, automated component washing is non-negotiable, but it comes at a significant resource cost. Each cycle consumes Water for Injection (WFI), electricity, and chemical detergents, and those costs accumulate across hundreds of cycles a year. At the same time, pressure to reduce operational resource use is growing across the industry.

Because cleaning parameters are strictly locked into validated cycles, facilities cannot simply alter wash recipes to save water or energy. Instead, achieving meaningful reductions in utility costs and Total Cost of Ownership (TCO) requires a strategic approach to equipment selection. By optimizing the underlying equipment architecture, manufacturers can lower resource consumption without altering the strict parameters of a validated clean.

This paper details innovations in pharmaceutical component washing that reduce resource use without sacrificing the validated performance critical environments demand.

Glossary:

- **CO_2eq (Carbon Dioxide Equivalent):** A metric used to compare emissions from various greenhouse gases based on their global warming potential, expressed in equivalent tons of CO_2.
- **Dead Leg:** A pocket or area in a piping system where fluid can stagnate, typically measured as a ratio of length to diameter (e.g., ≤2D).
- **EcoDesign:** A design philosophy that integrates environmental considerations throughout product development to minimize lifecycle environmental impact.
- **HVAC (Heating, Ventilation, and Air Conditioning) system**: a comprehensive mechanical setup that regulates indoor temperature, manages humidity levels, and controls air quality.
- **LCA (Life Cycle Assessment):** Systematic analysis of environmental impacts throughout a product's entire lifecycle, from raw material extraction through manufacturing, use, and end-of-life disposal.
- **Use Phase:** The operational lifecycle stage during which equipment is actively used. Typically represents the largest environmental impact for washing equipment due to electricity, water, and chemical consumption.
- **WFI (Water for Injection):** Highest grade pharmaceutical water, meeting stringent purity standards for critical applications, including final equipment rinse cycles.
- **Total Cost of Ownership (TCO):** A financial estimate encompassing direct and indirect costs over a product's lifetime. This includes long-term savings from reduced water, energy, and chemical consumption.

Introduction

When it comes to component cleaning in pharmaceutical manufacturing, consistent, repeatable results of a pre-validated solution are essential. Automated cGMP washers and washer/dryers help ensure validated component cleaning while mitigating the human error inherent in manual washing processes.

However, legacy and traditional automated cGMP washers often require high resource consumption, including water, Water for Injection (WFI), detergents, and energy. This intensive utility usage contributes heavily to a facility's environmental impact and operational costs.

Simultaneously, manufacturers face mounting pressure to reduce resource consumption as the pharmaceutical industry increasingly aligns with global sustainability initiatives, such as the United Nations' Race to Zero. The Race to Zero is a global campaign rallying pharmaceutical manufacturing companies, institutions, and regional governments to take rigorous, immediate action to halve global emissions by 2030 and achieve net-zero carbon emissions by 2050.[1]

The solution for facility managers or purchasing, procurement, and outsourcing professionals in the pharma and biotech industries is to reduce the consumption of critical resources during the use phase of equipment.

GEW 888 neo

Challenge and Solution:

The Resource Cost of Pharmaceutical Washing

Legacy pharmaceutical washer/dryers were engineered primarily to maximize efficacy and throughput, often at the expense of resource efficiency. Consequently, the operational lifecycle stage, commonly referred to as the use phase, represents the largest environmental impact for these systems. Each validated wash cycle demands substantial electricity, high volumes of water and WFI, and precise dosing of alkaline, acidic, or neutral detergents to remove difficult residues and insoluble powders. When multiplied across thousands of annual cycles, this cumulative resource consumption becomes a primary driver of a facility's overall carbon footprint and Total Cost of Ownership (TCO).

For process engineers, facility managers, and procurement professionals across pharmaceutical and biopharmaceutical production, Quality Control (QC) laboratories, and pilot plants, this presents a twofold challenge. Facilities must strictly adhere to cGMP regulations, including EU GMP Guidance Annex 1 and FDA guidelines, while simultaneously executing corporate or global sustainability mandates. Because cleaning parameters are locked into validated wash cycles, simply reducing utility inputs is not a viable option without risking a validated clean.

Addressing this operational bottleneck requires a fundamental rethinking of washer architecture. By optimizing the physical footprint, material composition, and the underlying hydraulic and electrical systems, facilities can achieve significant reductions in utility consumption without altering validated cleaning parameters. The Getinge GEW 888 neo has been specifically redesigned using EcoDesign principles to resolve these exact challenges, delivering uncompromising cGMP compliance alongside measurable improvements in resource use.

Maximizing Cleanroom Space

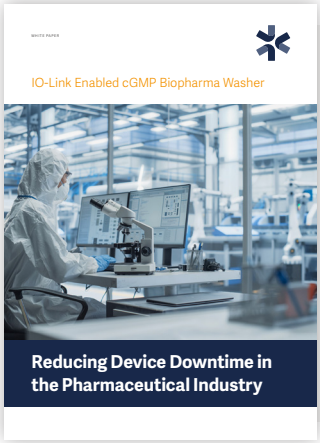
For facility engineers and project managers, cleanroom real estate represents a high capital investment. The physical footprint of processing equipment directly dictates facility design, HVAC load requirements, and overall operational efficiency.

To address space constraints, the GEW 888 neo has been engineered with a footprint reduced by 50% compared to its predecessor. By delivering high-throughput, cGMP-compliant washing within a compact 1.3 m² (14 sq.ft.) footprint, the GEW 888 neo allows process engineers to optimize cleanroom layouts. This spatial efficiency frees up critical area for additional production equipment or enables the design of smaller, more cost-effective classified environments.

The footprint reduction of the GEW 888 neo was achieved by rethinking the machine's structure and hydraulic layout. Through the optimized use of stainless steel in the rebuilt hydraulic circuit, the raw material weight was reduced by 37%, substantially decreasing the environmental impact associated with manufacturing and transport.

Beyond spatial optimization, the EcoDesign philosophy applied to the GEW 888 neo significantly lowers its embodied carbon footprint, a critical metric for procurement and sustainability teams evaluating capital expenditures.

Furthermore, the integration of advanced IO-Link technology streamlines the electrical architecture, shrinking the electrical cabinet and wiring requirements. As an internationally accepted standard (IEC 61131-9) for sensor and actuator communication, IO-Link utilizes bidirectional digital data transfer rather than traditional analog signals. This state-of-the-art interface facilitates seamless integration into existing facility control systems, enabling real-time monitoring of critical parameters like temperature, pressure, detergent flow, and conductivity. The digital communication protocol eliminates the need for manual parameter setting and repeated interval SOP recalibration, significantly reducing installation and commissioning times.
With location-based, point-of-issue diagnostics, the system provides unprecedented visibility into device performance, allowing technicians to execute preventive maintenance and "plug-and-play" sensor replacements. Consequently, the washer operates with maximum efficiency and minimal downtime, supporting stringent production schedules while reducing the Total Cost of Ownership (TCO).



White Paper: Reducing Device Downtime in the Pharmaceutical Industry

By leveraging advanced IO-Link technology the GEW 888 neo integrates seamlessly into new and existing Ilot automation systems. The use of IO-Link enables remote monitoring and control, enhanced diagnostics, faster compliance, improved uptime, and significantly reduces installation and commissioning times.

Learn more: [whitepaper about reducing device downtime in pharma]

Reducing Water Consumption and WFI Use in Validated Cleaning

Water consumption, particularly the generation and use of Water for Injection (WFI), is a primary driver of utility costs and environmental impact in pharmaceutical component washing. For chemical and process engineers, optimizing this consumption without compromising validated cleaning efficacy is a critical objective.

The GEW 888 neo features a fully redesigned hydraulic system that delivers measurable improvements in performance, efficiency, and water consumption. If dead legs occur, these are designed to ≤2D, minimizing residual water between phases.

An enhanced docking system introduces water directly beneath the wash rack with a tighter, more controlled seal. This improves spray distribution and cleaning effectiveness while simultaneously reducing overall water consumption. Together, these upgrades provide more reliable cleaning results, lower utility usage, and an operation with lower environmental impact without compromising throughput or performance.

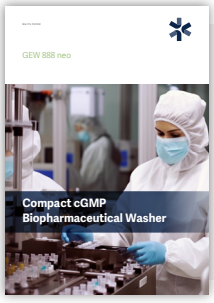
The final rinse stage, where WFI is used, is the most water and cost-intensive part of the wash cycle. Conventional recirculating rinse systems pass water through the chamber multiple times, accumulating contaminants with each pass and requiring higher volumes of WFI to achieve the necessary cleanliness level. Conventional single-pass final rinse (SPFR) solutions address recirculation but typically require a large separate water tank, adding to the machine's footprint and cost.

To resolve this limitation, the Getinge GEW 888 neo SPFR system eliminates the requirement for a bulky external tank. It relies on an advanced hydraulic layout and sanitary valves to disburse Water For Injection (WFI) directly through the chamber's spray arms, preserving the unit's compact footprint. Furthermore, the GEW 888 neo's SPFR ensures that the recirculation system is not utilized, thereby preventing increased conductivity levels that could result from residual water in hydraulic dead legs.

Benefits of GEW 888 neo SPFR

- No increase to external machine dimensions, preserving cleanroom space
- Conductivity monitoring confirms soil removal at the end of each rinse, providing a documented quality check
- Can be configured as a pre-rinse, a final rinse, or repeated multiple times within a single cycle

Whether applied as the final rinse phase (single-pass final rinse) or as a prewash step (single-pass first rinse), the Getinge SPFR solution minimizes contamination risk by preventing the recycling of contaminated rinse water. In systems where recirculation is used, the associated risk is not inherent to the recirculation itself, but depends on design factors such as the presence, number, and geometry of deadlegs, which must be appropriately controlled. Water only passes items in the chamber once before being drained, preventing contact with recirculated water. When used as a pre-rinse, the single-pass system removes bioburden before the SPFR phase. Depending on validation requirements, the single pass can be set to repeat multiple times while still benefiting from lower water consumption compared to standard SPFR systems.



White Paper: Compact cGMP Biopharmaceutical Washer

With cleanroom space at a premium, it can be challenging to find a high throughput cGMP washer that provides the requisite quality for cleanroom use in a compact footprint.

Learn more: [GEW 888 neo compact cGMP biopharmaceutical washer]

Reducing Energy Consumption in Component Drying

Drying is one of the most energy-intensive phases of a wash cycle. Conventional systems exhaust the heat accumulated during washing into the facility, directly impacting the HVAC system and thereby adding to the facility's cooling load. The result is a double inefficiency: energy consumed to generate heat, then more energy consumed to remove it.

The GEW 888 neo's redesigned drying system includes a heat exchanger that captures thermal energy accumulated in the chamber during the final rinse and uses it to pre-heat incoming drying air. The main circulation pump is equipped with a frequency drive, operating only at the speed each phase requires rather than at a constant maximum.

The drying system includes a heat exchanger that recovers the thermal energy accumulated in the chamber during the final rinse. This recovered energy is used to preheat the incoming air for the drying cycle, reducing overall energy consumption, helping pharmaceutical manufacturers meet sustainability goals like the UN's Race to Zero.

The choice of energy source is critical. To further reduce energy consumption and environmental impact, renewable energy sources should be used. Through the use of renewable energy sources, the use phase climate impact can be reduced by 46.5%.

Recommendations for Minimizing Environmental Impact

RENEWABLE ENERGY SOURCING
Up to 47% reduction in use-phase carbon impact (36% on average)

CYCLE OPTIMIZATION
Configuring wash recipes to the specific load minimizes unnecessary water and chemical use

SPFR UTILIZATION
Enabling Single Pass Final Rinse maximizes WFI savings

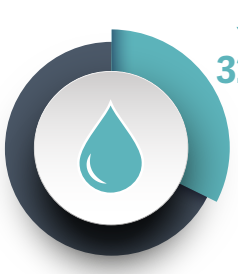
PREVENTIVE MAINTENANCE
Sustained efficiency through proper upkeep, supported by IO-Link diagnostic capability

DETERGENT SELECTION
choosing lower-impact detergents and calibrating dosage to process requirement

Third-Party Verified Life Cycle Assessment

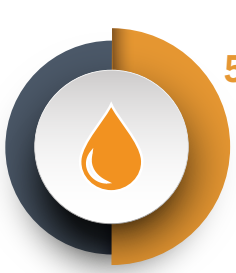
The environmental performance claims in this paper are grounded in a third-party verified Life Cycle Assessment (LCA). This comprehensive LCA evaluates the environmental impacts associated with every stage of the GEW 888 neo's lifespan, from raw material extraction through manufacturing, distribution, the operational use phase, and end-of-life disposal.

For procurement and project management professionals evaluating equipment investments, the LCA provides critical, data-driven insights into the Total Cost of Ownership (TCO) and environmental footprint. The assessment reveals that the use phase, specifically the consumption of electricity, water, and chemical detergents, accounts for the vast majority of the equipment's climate impact.



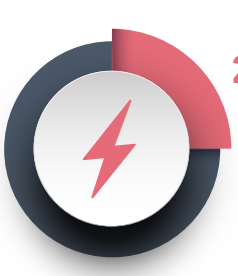
32%

Reduction in overall water consumption*



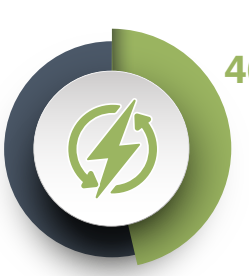
50%

Reduction in WFI consumption, approximately 7L of PW/WFI per rinse phase**



25%

Reduction in energy consumption***



46.5%

Reduction in energy consumption with renewable energy sources

HVAC load reduction through decreased heat and humidity exhausted into the facility****

* Annual water consumption: 138 m³ (based on 1,275 cycles/year)
** Water consumption is dependent on the selected load rack as well as on the timer set for the external single-pass rinse.
*** Annual electricity consumption: 4,147 kWh (based on 1,275 cycles/year)
**** Reduction is dependent of building configuration

Product Environmental Profile

The Product Environmental Profile (PEP) communicates the results of a Life Cycle Assessment (LCA). The LCA study follows requirements in ISO 14040 and ISO 14044, has been third-party verified by Miljögiraff, and was conducted using EIME v.6 software with LCIE Bureau Veritas datasets and European Commission impact assessment methods (PEF EF 3.1). The results presented from this study are based on a typical usage scenario.

Read the full PEP: GEW 888 neo Product Environmental Profile

Conclusion

Reducing the environmental impact of component washing requires a strategic approach to equipment selection. For pharmaceutical manufacturers, the primary objective is to lower the consumption of critical resources without altering the strict parameters of a validated clean. The Getinge cGMP GEW 888 neo washer provides the equipment architecture needed to achieve this reduction easily and reliably.

By optimizing the Getinge GEW 888 neo using integrated EcoDesign principles, it ensures the repeatable, high-throughput cleaning that is essential for biopharmaceutical production while significantly lowering overhead utility costs.

While the immediate operational benefit is a drastic reduction in utility costs and resource consumption, this efficiency inherently supports broader corporate objectives. For process engineers and facility managers, the GEW 888 neo enables seamless integration that maximizes cleanroom real estate while maintaining strict adherence to ASME BPE and cGMP standards. For procurement and project management teams, the third-party verified Life Cycle Assessment provides the transparent, data-driven assurance needed to accurately project a lowered Total Cost of Ownership (TCO). By significantly cutting resource usage, the GEW 888 neo empowers pharmaceutical manufacturers to reduce their overall environmental impact, seamlessly aligning facility operations with global sustainability initiatives.

A Trusted Partner in Pharmaceutical Production

Getinge is a highly recognized global provider of systems that contribute to productivity improvement, repeatability, and cost-efficiency in biopharmaceutical manufacturing. With deep proficiency in the design, production, and validated installation of cGMP washers, Getinge solutions have evolved alongside generations of advances in science and medicine.

Getinge GEW Series cGMP Washers have been specifically designed for the cleaning of components and production equipment used in pharmaceutical drug manufacturing. All Getinge units are crafted with components of superior quality that support contamination control, promote a sanitary process, and ensure safe and dependable results that are essential to safeguarding product, personnel, and the environment in a pharmaceutical facility. From the polished stainless-steel surfaces to the user-friendly machine interfaces, each part is intricately designed into a highly efficient system that is indispensable to quality assurance.

By choosing the GEW 888 neo, facilities gain a reliable solution that drives down operational costs while delivering the high-throughput, validated cleaning critical to modern pharmaceutical production.

Complete Range of cGMP GEW Washer/Dryers

GEW 888 neo

480 L (17 cu.ft.)

GEW 9109

810 L (29 cu.ft.)

GEW 101210

1212 L (43 cu.ft.)

GEW 131313

2146 L (76 cu.ft.)

GEW 131820

4680 L (165 cu.ft.)

Pharmaceutical Production Solutions

Getinge is an industry leader in product solutions for pharmaceutical production sterility testing, API handling and aseptic filling. Our isolation technology and isolator manipulation devices are trusted worldwide to provide a safe and controlled environment for your most critical steps.

Learn more: getinge.com/int/products-and-solutions/pharmaceutical-production/

References

1. United Nations Climate Change, "Race to Zero Campaign," United Nations Framework Convention on Climate Change, https://climateaction.unfccc.int/Initiatives?id=Race_to_Zero.

GETINGE

With a firm belief that every person and community should have access to the best possible care, Getinge provides hospitals and life science institutions with products and solutions aiming to improve clinical results and optimize workflows. The offering includes products and solutions for intensive care, cardiovascular procedures, operating rooms, sterile reprocessing and life science. Getinge employs over 10,000 people worldwide and the products are sold in more than 135 countries.

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