



Enhancing Clean-in-Place (CIP) Systems with Pulsafeeder's NextStep Pump Technology

Abstract

Clean-in-Place (CIP) systems are critical for industries where hygiene and contamination control are mandatory—such as food and beverage, pharmaceuticals, and specialty chemical manufacturing. These systems automate cleaning through validated, programmed steps that ensure compliance with stringent safety and quality standards. This white paper explores the challenges of CIP operations and demonstrates how Pulsafeeder's NextStep pump technology addresses these challenges with precision, reliability, and cost efficiency.

1. Introduction

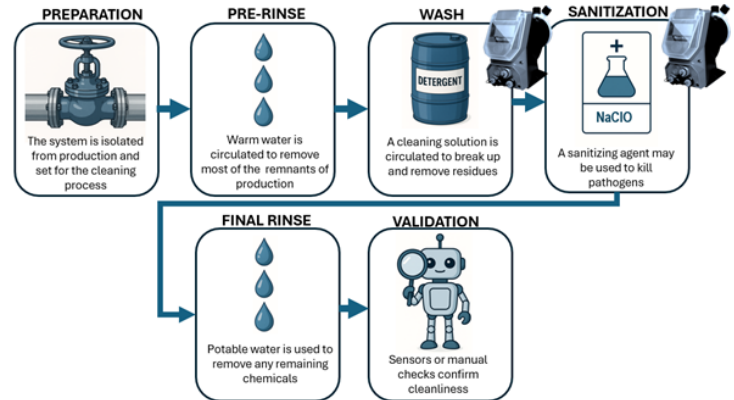
Before the advent of automated cleaning systems, operators manually cleaned production equipment between batches—a time and labor-intensive process prone to human error. Inadequate cleaning could lead to cross-contamination, bacterial growth, and severe health risks, including foodborne illnesses and product contamination.

To mitigate these risks, regulatory bodies such as the U.S. Food and Drug Administration (FDA) enforce strict standards under the Food Safety Modernization Act (FSMA) and Current Good Manufacturing Practices (CGMP). These regulations mandate comprehensive food safety plans and validated cleaning protocols to prevent contamination and ensure consumer safety.

2. CIP System Overview

CIP systems are engineered to clean and sanitize equipment without disassembly, ensuring compliance with federal safety requirements. A typical CIP cycle includes:

- 1. System Isolation** – Automated valve closures separate production lines from cleaning circuits.
- 2. Pre-Rinse** – Heated water flushes out residual product.
- 3. Detergent Wash** – Surfactants and chemicals (e.g., caustic soda, nitric acid, phosphoric acid) break down stubborn residues.
- 4. Sanitization** – Potent agents such as sodium hypochlorite, hydrogen peroxide, or peracetic acid eliminate pathogens like Salmonella, E. coli, and Listeria.
- 5. Final Rinse** – Clean water removes chemical traces.
- 6. Verification** – Manual and/or automated inspections confirm cleanliness using advanced sensors and validation tools.



3. Challenges in CIP Operations

Despite their sophistication, CIP systems face three major challenges:

- Precision Dosing** – Metering pumps must deliver cleaning agents at consistent, accurate flow rates to ensure proper chemical concentration and mixing.
- Chemical Resistance** – Equipment must withstand aggressive detergents and sanitizers without degradation, leakages and failure.
- Cost Control** – Overdosing chemicals increases costs and environmental impact, while underdosing risks contamination and downtime.

4. NextStep Pump Technology: The Solution

Pulsafeeder's NextStep pump technology addresses these challenges:

- Chemical Compatibility** – Designed to handle caustic soda, acids, and other aggressive sanitizers without compromising durability.
- Superior Flow Control** – Stepper motor technology delivers near-laminar flow for unmatched dosing accuracy, avoiding slugs of concentrated chemical entering the stream.
- Reliability in Critical Environments** – Proven performance in pathogen-sensitive applications where compliance is mandatory.

NextStep's impressive 3300:1 turndown ratio allows a single pump to handle a broad range of hydraulic conditions, making it ideal for systems with varying operational requirements. In addition, NextStep offers multiple operating modes, Modbus communication capability, a variety of accessories, and built-in features such as a low tank level alarm and foot valve. NextStep provides everything needed to seamlessly integrate into virtually any CIP system, right in the box.

5. Application Scenarios

NextStep pumps enhance CIP systems across diverse industries, including:

- Breweries, wineries, and distilleries
- Dairy transfer and processing
- Fruit and vegetable handling
- Beverage production
- Meat processing and packaging
- Bakeries and food manufacturing
- Pharmaceuticals and biotechnology
- Health and wellness products
- Cosmetics and personal care
- Specialty chemical batch production

Wherever consumer safety and regulatory compliance are essential, NextStep technology delivers value.

6. Conclusion

CIP systems are indispensable for maintaining hygiene and regulatory compliance in critical industries. Pulsafeeder's NextStep pump technology ensures precise chemical dosing, robust chemical resistance, and operational reliability—reducing costs while safeguarding product integrity. For manufacturers seeking to optimize CIP performance, NextStep represents a proven, future-ready metering pump solution.



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