Attention to Detail

Improving CIP Efficiency

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That was 1995. In 2019, a brewer who cares about quality beer needs to care about quality CIPs as well.

AUDITING AND STANDARDIZING THE CIP PROCESS

As brewers, we follow recipes meticulously, weighing hops to the gram, getting the water to grist ratio correct for the mash, and adjusting salts seasonally to compensate for incoming water specs. So then why do otherwise careful brewers sometimes simply eyeball quantities and other metrics for their CIP procedures, allowing for wild swings in contact time and concentration?

Brewers at all levels can benefit from an audit of their CIP process to establish a baseline standard. Once the process has been dialed in and the equipment validated for cleanliness, that CIP recipe should be documented as an SOP and used in the process of training brewers.

“You can’t control what you don’t measure,” is the brewing advice I’ve returned to time and time again. Establishing a baseline is a good place to start. A kitchen timer and a titration kit are tools enough to begin standardization. Timing everything, including initial

Getting a small CIP grant set up will allow the ability to mix up solution, get the right chemical concentration, and burst-rinse the vessel to knock off the worst soils.
burst rinses, filling and draining times, chemical contact time, and especially post-chemical rinses, will help establish a standard. In the simplest, one-way CIP timing is important when making up chemical solutions to ensure a consistent concentration. Once the right concentration has been established and verified through titration, incorporating that chemical amount and the associated fill time into the baseline recipe is the next step.

Brewers who have access to a dedicated CIP solution vessel, brink, or grant can more easily standardize the amounts, timing, and process for making up the solution, since they have the advantage of being able to reuse that solution for subsequent CIPs. For vessel CIPs, having solution ready to go and burst rinsing to drain for the first rinse is an extremely effective method for removing gross soils. Once the initial soils are removed, caustic can be sent back to the brink relatively clean for reuse.

Of course, the more sophisticated the CIP setup, the more tools are available for regulating the CIP procedure. Fully automated CIP plants with flowmeters and conductivity probes make it much easier to adjust a CIP recipe and then maintain that standard.

**DESIGNING CIP RECIPES**

Tailoring your CIP recipe for a particular vessel requires several considerations:

- Check the manufacturer recommendation for flow rate and pressure of the sprayball or cleaning machine in the vessel. Having pressure or flow that is too low or too high can result in lowered impingement and ineffective cleaning.
- Each port on a vessel deserves its own solution supply. In a fermentation vessel (FV), the sprayball line, blowoff line, racking arm, standpipe, dry hop line, etc. all need proper flow and contact time.
- Larger vessels can benefit from an ambient CIP rather than a hot one. For example, 2 percent caustic works well at 20°C (68°F) with the right setup. With larger vessels, a hot CIP forces tank stainless steel to expand and contract every time it’s cleaned, increasing metal fatigue and reducing the vessel’s life.
- Burst rinsing after a solution run and allowing the vessel to drain (or pump down) completely after each burst can save time and rinse water, as the chemical solution is being removed instead of diluted with more water. If using a pump, choose a pump that is self-priming.
- Rinsing until there is no more chemical detected is sufficient. For caustic, this is easy to check by dripping phenolphthalein into the rinse water as it goes down the drain. The moment it no longer changes color, the system is sufficiently rinsed.
- FVs used for maturation only, or bright beer only, don’t necessarily need to be cleaned with caustic, and should go through the associated CO₂ depressurization and venting steps. Many chemical suppliers offer a dedicated acid cleaner with detergent and surfactant properties, which is sufficient to clean a vessel with a low soil load. A monthly or quarterly caustic CIP is still a smart idea.
- Concentration control is key. A good rule of thumb is 2 percent for caustic and 1 percent for acid. Most chemical suppliers will provide guidelines for the chemicals they supply and will sometimes include titration kits specific to those chemicals.
- Vessels with steam jackets or other types of heated surfaces can benefit from “acid cracking,” the practice of breaking up and removing burnt-on wort by running an acid solution before a basic solution.

**PROCESS EQUIPMENT**

Pipes, hoses, and other process equipment used in CIP also deserve consideration.

- Pipe and hose systems require turbulent CIP solution flow for effective cleaning. A simple rule of thumb is 2–2.5 m/s of velocity in the line. This is then dependent on line size to determine the flow rate needed to exceed the threshold for turbulent flow. For example, for a DN50 (2”) pipe, flow should be between 141 hl/hr and 176 hl/hr (62–78 gpm).
- Heat exchangers (particularly in this crazy IPA world where hop solid volumes far exceed the amount of wort protein required to hold a decent trub pile together) can benefit from a reverse-flow CIP. This can be done by simply removing hoses from the heat exchanger and switching the inlet and outlet, or by creative valving.
SANITATION

Any CIP plan must include sanitation. For breweries that aren’t working around the clock and have brewing equipment sitting idle regularly, it makes sense to CIP after use, and sanitize before use. Continuous production brewers will often do both as steps in the same process, and then set a time limit that triggers a re-sanitization if the equipment isn’t used within that time.

For FVs and other cold-side vessels, a chemical sanitizer that is easy to use and has a low contact time works best. Piping and soft lines can use chemical sanitizers, but sanitizing with heat can be more effective at finding all the potential beer spoiler hiding places: micro-cracks in hose interiors, nicked gaskets, bad welds in piping, extraneous valves, and other process equipment. Recirculating 80°C water (176°F) as measured at the CIP return for 30 minutes is enough for effective sanitization. For sensitive areas like yeast propagation and storage, live steam can be used for both vessels and piping.

EXECUTING THE PLAN

Once the baseline is established and there is a plan in place for each type of CIP it’s time to roll out those standards. Getting all brewers on board with making the measurements and following the procedures requires documentation and training time. If the associated brewhouse or cellar logs don’t already account for it, a simple CIP log with target values for time or volume for each step, along with places to record actual values for the measurements taken, is effective documentation.

Bringing in a new procedure (or improving a current one) wouldn’t be complete without mentioning the right tools for the job. Absolutely paramount is appropriate personal protective equipment (PPE) that is clean and in working condition. Anyone working with chemicals should have their own complete set. Measuring tools should be kept clean and readily available. If the chemicals can only be measured by hand, setting up the chemical supply area immediately adjacent to the equipment being cleaned will help minimize chemical spill cleanup.

A thorough inspection of any brewhouse or cellar vessels, usually while detail cleaning, is any brewer’s first task once the CIP is complete. Brewhouse vessels are simple, but FVs and yeast tanks can be trickier. Any signs of brünhefe or other visible soil indicate that the CIP was not effective and contact time needs to increase if the concentration was correct. A micro swab can find anything that is living on the FV walls, but the time it takes to evaluate makes it inefficient. For a more robust
validation, a handheld instrument that can detect adenosine triphosphate (ATP) using bioluminescence will reveal trace amounts of beer or yeast residue, indicating that the vessel was not cleaned properly.

Piping, hose, and heat exchanger CIP validation takes a bit more effort. Hoses and piping can be checked after rinsing by sampling the rinse water and micro plating, or verifying with an ATP instrument. Long pipe runs that can’t be broken for inspection easily may require a borescope for accuracy.

Heat exchangers are the bane of every brewer’s existence, and that’s especially true when it comes to inspection. Changing up the CIP for a heat exchanger should be timed so that it can be disassembled and inspected within a few weeks after making the change, in order to validate the effectiveness of the CIP. Practical brewers who have time to let their heat exchanger go idle will often leave it packed with a solution particularly suited to soak cleaning, in order to augment the effectiveness of the regular CIP.

STICKING TO THE PLAN
Once the CIP plan is in place and validated, maintaining and improving the plan is the next task. The CIP logs created may also have a place to record a pass/fail grade for the CIP based on the quality check, which can provide insight into how consistently effective that CIP recipe is and inform recipe updates.

It may be necessary to create a customized recipe for a specific beer brand or yeast strain. Brands with a high wheat malt inclusion, for example, leave a much more proteinaceous krausen ring that takes more contact time or a higher chemical concentration to remove. Yeast strains that ferment vigorously will spread brunbête across more of the FV interior and may require some recipe tweaks.

Other changes that a brewer can make to improve CIP efficacy include:
• Upgrading sprayballs to mechanical cleaning machines for better impingement.
• Titrating reused caustic for carbonates to ensure effectiveness.
• Automating CIP solution makeup for precision and reduced chemical handling.
• Partnering with a chemical supplier. Many suppliers offer free consultation or auditing of CIP processes, and often have tools that can help ensure that CIP cleaning is optimized.

Every brewer has heard the adage that brewing is 90 percent cleaning. If that’s true, then there’s every reason to standardize each cleaning process and treat CIPs with the same consistency and attention to detail that we demand in our brewing process. That shift beer at the end of the day is even more satisfying when you know it came from the cleanest brewing equipment possible.

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