The meaning of cleaning

WHILE MORE RIGOROUS CLEANING IS CONSTANTLY BEING DEMANDED IN MOST INDUSTRIES, THE ENVIRONMENTAL LOBBY IS CALLING FOR REDUCED USE OF ENERGY, CHEMICALS AND, PARTICULARLY, WATER IN ALL MANUFACTURING PROCESSES.

The relentless increase in the number and scope of safety regulations has brought renewed pressure on the food, beverage, pharmaceutical and biopharmaceutical industries for more rigorous clean-in-place (CIP) regimes and effective monitoring and recording of the cleaning processes used.

At the same time, however, the environmental lobby is demanding reduced use of energy, chemicals and, particularly, water in all manufacturing processes. All of these are primary components of traditional CIP systems and it would be reasonable to assume that better, safer cleaning might require more, rather than less, of all three.

Add to these factors the demands placed on food processors for shorter runs – and so more cleaning – to meet retailer demand, plus the enormous increases in quality standards from those same supermarkets, and effective CIP appears under pressure from several different directions.

In fact, CIP specialists have risen to the challenge, not only by introducing new technologies but also by re-engineering and redesigning traditional systems to meet the different demands now placed upon them.

Some sectors, notably biopharma and pharmaceutical producers, have clear and established guidelines, such as GAMP, which enable machinery companies and CIP installers to understand what is expected.

Rules for biopharma

For example, biopharma manufacturers can follow the ASME-BPE 2005 guideline, issued by the American Society of Mechanical Engineers which lays down strict rules on the types of materials to be used, surface finishes, tanks and even welding specifications. Most end users and their suppliers accept these as targets for compliance purposes.

In the food sector, standards can be much more varied, although in the UK most food manufacturers tend to work to retailer guidelines for hygiene and cleaning practices. However food processors who export their products must be aware also of local regulations which vary from country to country.

In an attempt to foster better understanding and greater uniformity in the food industry the World Trade Organisation has recently opened its Food Safety Database to general use. Listing food safety and export requirements from global sources, as well as other important inter-governmental and contact details, the WTO's aim in allowing greater access is to break down barriers to trade which these numerous and complex requirements can bring about. (http://spsims.wto.org).

CIP where it's needed: *Typical mobile Suncombe CIP unit can be moved from line to line*

However the reality is that many small food processors still use basic methods of cleaning machinery, such as wash-in-place (WIP), which have no specific standards to follow and involve a degree of manual intervention, along with basic CIP systems.

Dave Adams, senior technical manager at CIP design and manufacturing specialist Suncombe has seen a steady improvement in CIP use and practice in his 25 years in the industry. In particular he believes the almost daily increase in documentation and validation

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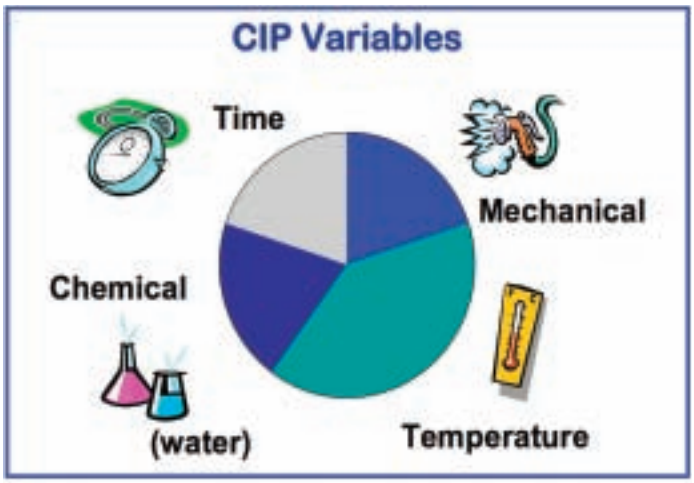
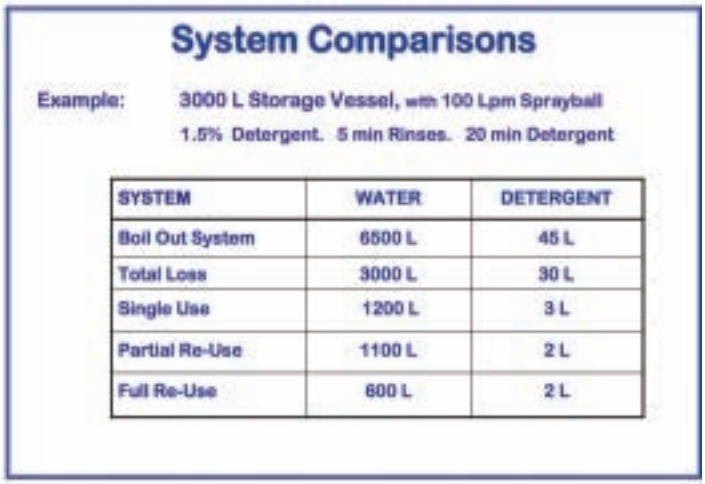


Modern CIP tries to balance cost, efficiency and environmental impact



SYSTEM	WATER	DETERGENT
Boil Out System	6500 L	45 L
Total Loss	3000 L	30 L
Single Use	1200 L	3 L
Partial Re-Use	1100 L	2 L
Full Re-Use	600 L	2 L

Use of water and detergent is high in some CIP systems

requirements is a good thing and sees these practices from the pharmaceutical sector pushing more into the dairy, beverage and general food sectors.

"The use of sensors, probes and transmitters to feed back information during the CIP process can greatly enhance the control the operator has over the 'recipe' to ensure no phase in the cleaning cycle is completed until pre-determined parameters, (temperature, solvent concentration, detergent levels, etc), have been met. Some systems even have turbidity meters to check the water is flowing in the right pattern," says Mr Adams.

Environmental credentials

Which system of CIP to choose is now being decided by its environmental credentials as much as for its efficiency and cost.

In Europe the Integrated Pollution Prevention Control Directive, (IPPC 96/61/EC) came into effect in October 2007 with the aim of improving environmental protection standards in manufacturing. In response, the CIAA, Confederation of Food & Drink Industries in the EU has launched a dedicated website and published a 64 page booklet to help its members reduce their environmental impact and share best practice, particularly among the smaller processors, (http://envi.ciaa.eu).

Meanwhile in the UK the Food and Drink Federation has committed its members to using 20 per cent less water by 2020 than they do today. A typical dairy plant uses 65 per cent of its total water consumption in CIP (40 per cent) and manual (25 per cent) cleaning. So the need to act is urgent and the forces being lined up against some current CIP systems are formidable.

All CIP systems have their advantages and disadvantages:

- Boil Out systems are cheap to install and good at cleaning complex mixers and other difficult shapes. However they use a lot of detergent, water and energy and have a long cleaning cycle. They are also difficult to monitor.
- Total Loss systems again suffer from high water and detergent use and a long clean time. However, they are simple to operate and offer a better health and safety regime, while still being hard to monitor.
- Single Use systems offer better flexibility, good economy and a low risk of cross contamination. However they are not suitable for large, centralised systems.
- Re-use systems are notable for their lower water and detergent consumption and centralised controls and structure. But they tend to be inflexible and cost more to install. There is also a higher risk of cross contamination.
- Mobile units, such as the MP3 Mobile CIP System offered by Multiplicity, are ideal for small cleaning jobs and reduce the amount of pipework necessary. However there are usually heating problems and limits to the size and capacity plant they can service.

Overall, Dave Adams at Suncombe suggests a clear evaluation of the cleaning risk before any decision is made on the type of CIP installation required. Also important is the degree of flexibility built into the system, often by customisation and use of modern components. For example traditional 'pepper pot' spray heads are now being superseded by rotating or jet sprays which are both more efficient and more effective.

Again, while variable speed pumps are more costly, they allow greater control of the flow rate and turbidity which can reduce water consumption and cycle times considerably.

The future direction of CIP technology may not be about the equation between water, detergents, solvents and energy as several new cleaning methods have been developed:

Ozone gas is an emerging tool in the food industry and is 50 times more powerful than chlorine, which is the normal oxidising agent. The advantages are that ozone is an effective disinfectant at low concentrations and leaves no toxic by-products. It also eliminates the need for the standard Five Step cleaning cycle – hot water rinse/foam/rinse foam/chlorine/water rinse – so reduces man hours needed and water requirements substantially.

Laser cleaning improves the water factor even more, as none is required at all. A concentrated laser beam strikes the surface to be cleaned for as little as a thousandth of a second. The radiation energy turns to thermal energy and simply vaporises any contaminant. The larger the absorption of the surface, the easier it is to remove the contaminant.

This CIP method has found a particular niche

Vacuum CIP for beverage tanks

KHS has developed a vacuum CIP system for cleaning beverage tanks which eliminates the need for return pumps in the tank area and reduces loss of cleaning fluid in the process cycle, says the company.

The vacuum system, which is installed on the CIP frame, uses the negative pressure created to return all the cleaning fluid from the pipelines and tanks to the CIP tank. Traditionally a certain amount of fluid had to remain in these areas to avoid damage to the pumps in the storage tank area.

The CIP system virtually eliminates mixing

Typical CIP Programme

Step	Operation	Cleaning Agent	Temp. (°C)	Time (Min.)	Usage
1	Pre-Rinse	Fresh* water	20 – 30	2 – 5	To drain
2	Alkali Clean	2% Caustic	70 – 90	5 – 15	Re-circulated
3	Intermediate rinse	Fresh* Water	20 – 30	1 – 5	To drain
4	Acid clean	1% Phosphoric	50 – 70	3 – 10	Re-circulated
5	Final Rinse	Fresh Water	20 – 30	4 – 6	To drain**
6	Drying	Sterile Air	20 - 50	20 - 30	Drain outlet

Notes: * *May be possible to re-use final rinse of previous wash*
** *Final rinse may be sent to re-use tank*

CIP cleaning cycles normally take 40-60 minutes

Monitoring Systems

Conductivity	To Monitor Strength To Separate Phases
Temperature	In Feed Line to Control In Return Line to Monitor
Flow	In Feed & Return to Confirm Rate
Pressure	In Feed Line for Spray Device In Return for Integrity Testing
Conductivity	In Return Line to Route Effluent
Time	From the Control System

Effective monitoring is essential to validate the CIP process

in cleaning conveyor baking ovens, where the laser is placed between the removal of the patty and the introduction of the new dough. There is no interruption to the baking process and no need for water or chemicals, so downtime is virtually eliminated. Indeed new applications for laser clean-in-place are emerging constantly.

Vigorous cleaning with ice

Water Ice Blast is used where more vigorous cleaning is required and has traditionally relied on high pressure water for the purpose. By turning the water to ice particles, both the pressure and flow rate are minimised. Each ice particle acts as a scrubber which dislodges particles and then turns to water, when it can be easily flushed away. This method requires no abrasives, chemicals or detergents and creates no dust.

A typical comparison between water blast and ice blast shows that the former uses 10-50 litres/min at 10-100 bar, while the latter uses 1 litre/min at 4-16 bar. Dry ice can be used

of the cleaning solutions which can happen during changeovers in the cleaning cycle, claims KHS. As a result there is potential saving in the use of caustic and acid as well as in total water consumption.

The flushing cycle has been reduced drastically while the need to keep the system filled with water is eliminated completely.

With reduced use of cleaning agents and water the CIP tanks can now be designed for smaller capacities than has been possible, by as much as 50 per cent for some applications, says the company.

The KHS CIP vacuum system operates at fluid temperatures up to 50 deg C which can result in lower energy requirements for the cleaning cycle and, according to the company, making the whole process much faster.

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when moisture in the atmosphere is not acceptable.

The last word goes to Suncombe's Dave Adams: 'We work with machinery suppliers, systems integrators and end users in about equal proportion. The message is the same to all of them. Design your installation or equipment with CIP in mind, so ensure there are no 'dead legs' in the pipe work, surface finishes are the correct standard, CIP circuits are balanced and welding techniques leave a crevice free finish.

"In addition the complete line should be drainable, contain no pockets or ledges, gaskets and seals should be crevice free and made of approved materials, fittings such as valves should be easy to clean and hose and pipework kept to a minimum with as few connections as possible. Finally confine cleaning solutions in a particular area to avoid leaks and contamination."

Of course this may be seen as an 'ideal world' scenario to some manufacturers. The truth is that the costs associated with product recalls, contamination risks where highly active ingredients are used and the potential loss of large contracts from major retailers places CIP at the heart of the production process, not as a necessary but inconvenient 'add on'.

This is not a lesson which needs to be learnt by the vast majority of pharmaceutical, biopharma, dairy and major food producers for whom CIP and, when used, SIP (Sterilise In Place) is common practice and of the highest standard.

The challenge comes at the small to medium processor level and where retailers are now sourcing more and more products from manufacturing plants in emerging economies, such as Vietnam or Eastern Europe.

Finally, Baldor has added a range of IEC-frame models to its range of stainless-steel AC motors. These units are designed for maximum corrosion resistance in cleaning environments where equipment is exposed to high pressure water jets and significant levels of caustic chemicals, says the company.

The motors, which are available initially in IEC D80, 90, 100 and 112 frame sizes and spanning a power range of 0.37 to 4kW, are particularly suitable for food, dairy, beverage and pharmaceutical applications, says Baldor. ■

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