CIP Optimisation

One mans opinion

kersia®
INVENTING A FOOD SAFE WORLD

Paul Bagshaw

Technical Service Manager (Kersia UK)

Paul began working at Kersia UK in 2008 as a Hygiene Auditor for the Foodservice, Hospitality and Retail Division before moving on to become a Hygiene Technologist.

In 2013 he was promoted to the role of Technical Service Manager, primarily providing customers with additional technical support in the form of investigations and audits.

Paul has an interest in Cleaning in Place (CIP) as well as hygienic design of equipment and has contributed to EHEDG working group creating and more recently updating "*Guideline 50: Hygienic Design Requirements for CIP Installations"*.

Kersia
A Global Footprint

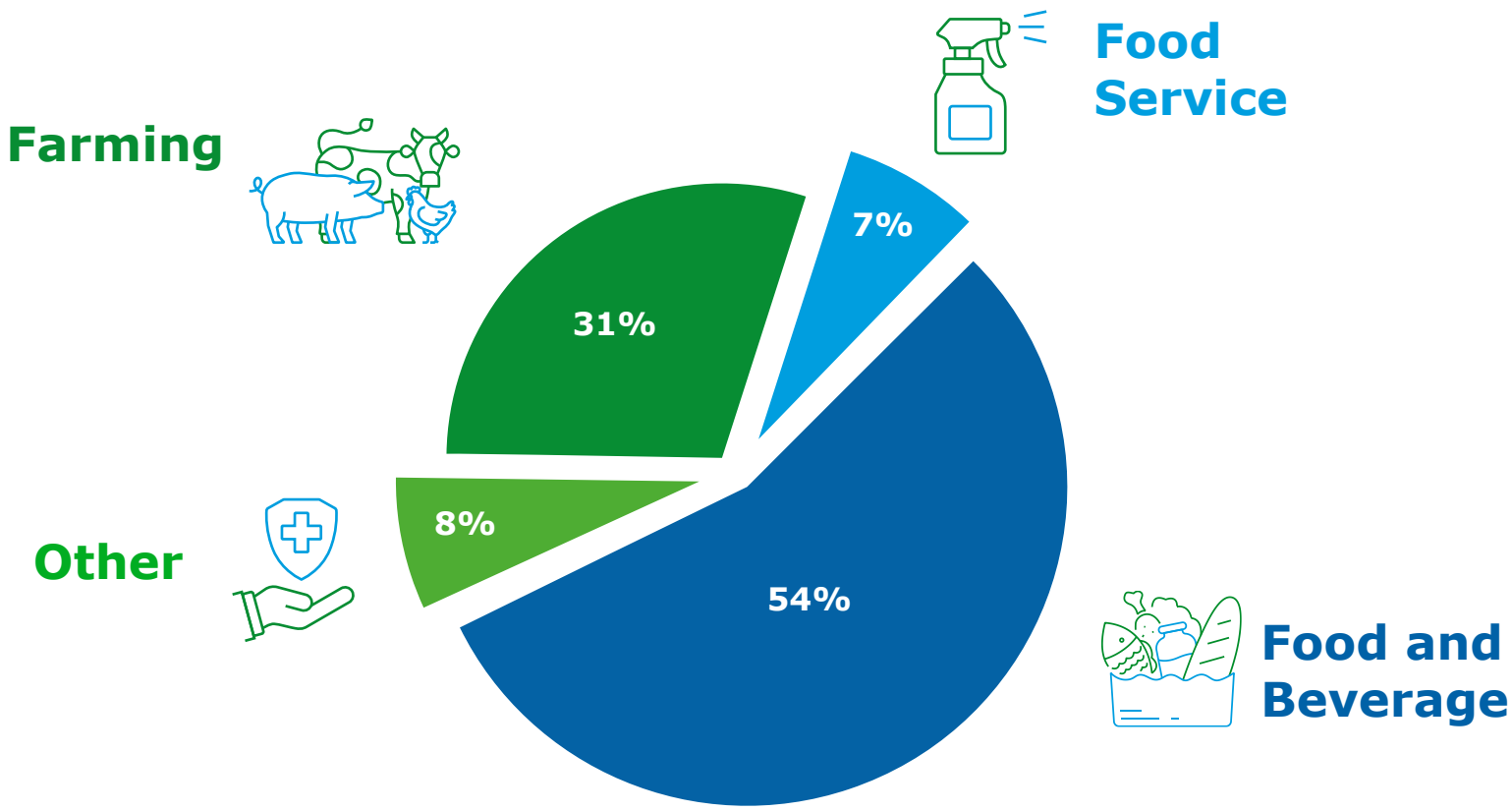
65%
EUROPE

16%
AMERICAS

12%
APAC

6%
MEA

Kersia
Distribution



Optimisation

“THE ACTION OF MAKING THE BEST OR MOST EFFECTIVE USE OF A SITUATION OR RESOURCE”

kersia
INVENTING A FOOD SAFE WORLD

Why?

THE FOOD & DRINK INDUSTRY IN THE UK ACCOUNTS FOR:

- ~14% of energy consumption by UK businesses and 7 million tonnes of carbon emissions per year
- ~10% of all industrial use of the public water supply
- ~10% of the industrial and commercial waste stream
- ~25% of all HGV vehicle kilometres in the UK
- ~12.5% of the UK's workforce

Why?

A TYPICAL CIP PROCESS REQUIRES LARGE INPUT OF WATER, CHEMICALS & ENERGY AND INVOLVES SIGNIFICANT PLANT DOWNTIME.

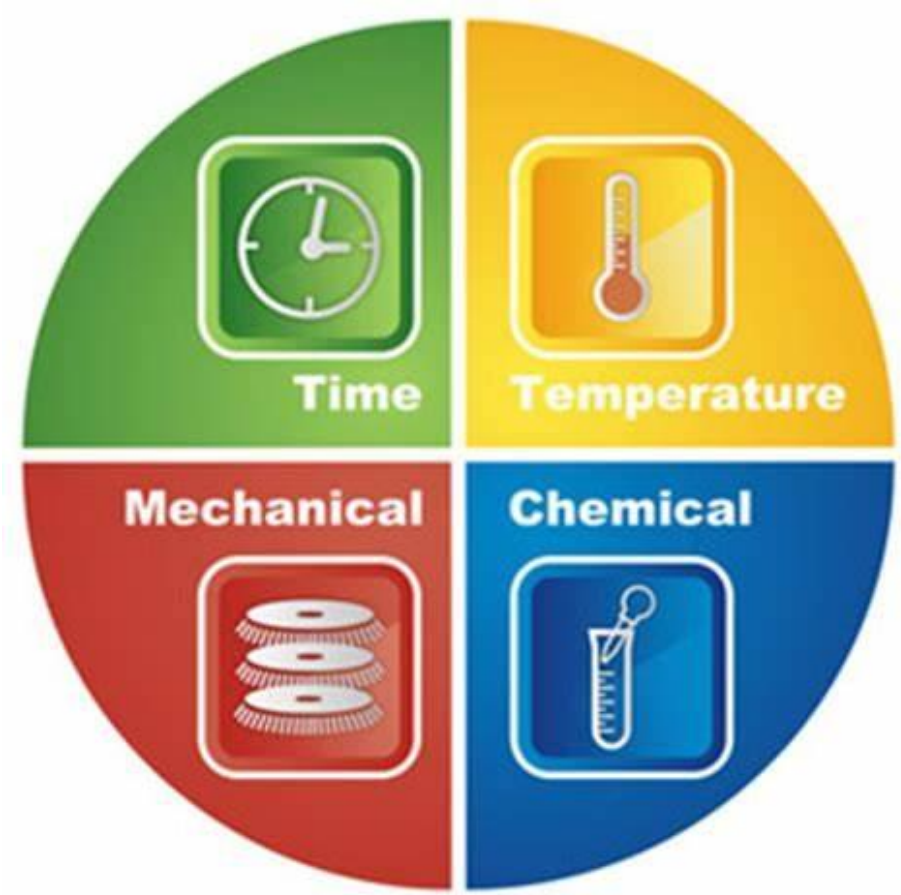
- A milk plant is likely to use 13% of its energy on CIP.
- A food and beverage plant will spend 20% of each day cleaning equipment.

What’s our objective?

- Highest production uptime
- Lowest water use possible
- Lowest energy use possible
- Lowest chemical use possible
- Lowest waste generation possible

Sinners Circle

- Thermal energy
- Chemical energy
- Mechanical energy
- Time
- All 4 are in balance, to reduce one we may need to increase another



Sinners Circle
Temperature

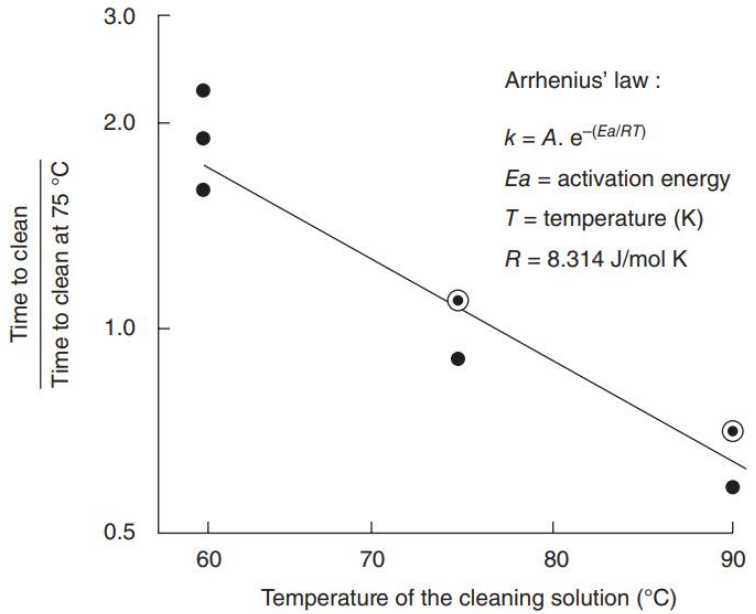
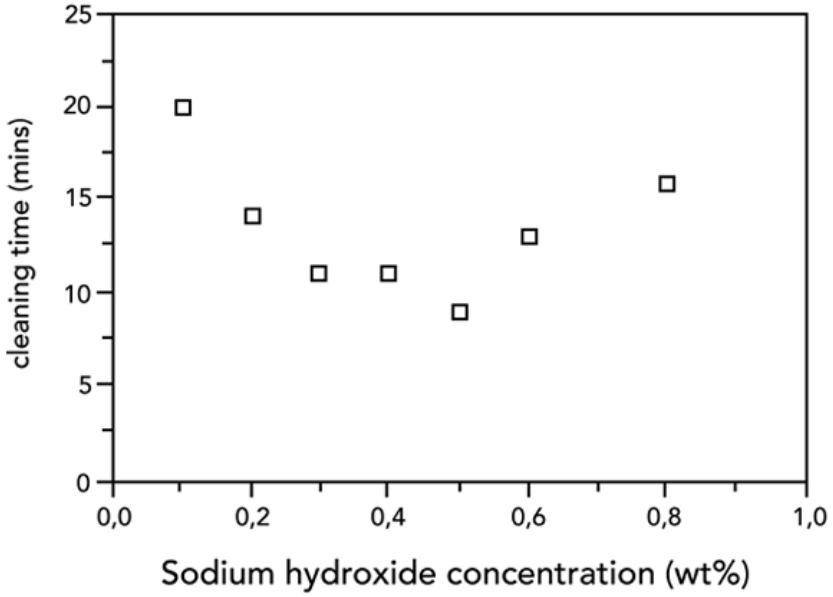


Fig. 10.2 Cleaning time as a function of the cleaning solution temperature (Timperley and Smeulders, 1988).

- Lower temperature increases time to clean
- Higher temperature reduces time to clean
- However higher temperatures may denature proteins, burn on some soiling

Sinners Circle
Chemical



Effect of NaOH concentration on cleaning time of a whole milk deposit at 50 °C

Source:
M.R. Bird and M. Bartlett Trans IChemE vol.73 part C June, pp 63-70, 1995

- Low caustic strength increases time to clean
- High caustic strength decreases time to clean
- Optimum target for caustic cleaning

Sinners Circle
Mechanical

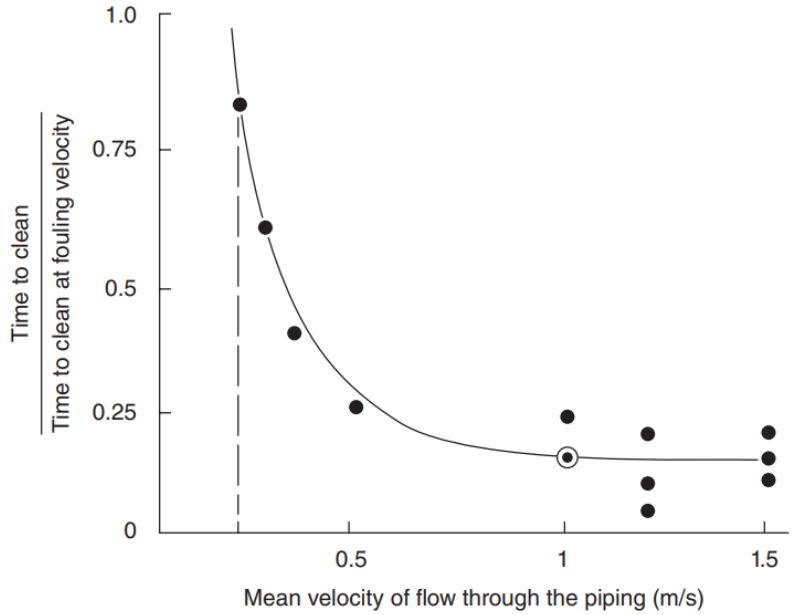


Fig. 10.3 Cleaning time as a function of the mean velocity of cleaning liquid through pipelines (Timperley and Smeulders, 1988).

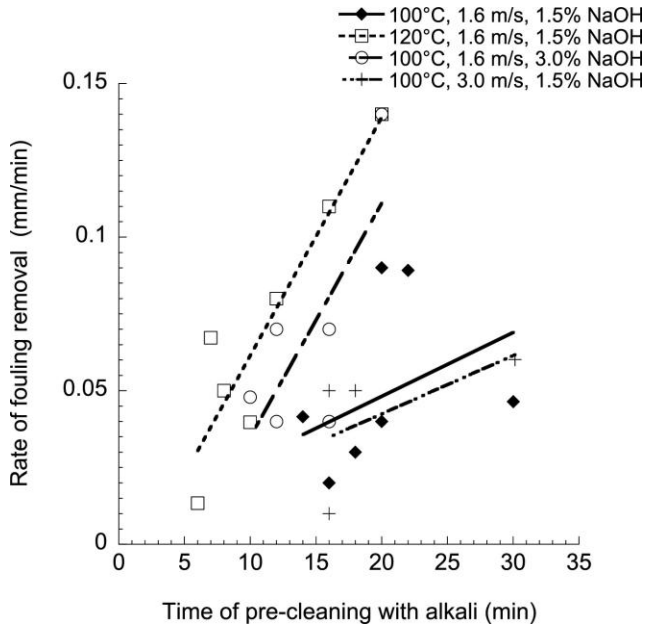
- Low flow increases time to clean
- High flow reduces time to clean
- Little benefit beyond 1 – 1.5 m/s

Sinners Circle

- Optimisations is not restricted to a reduction in any of the 3 energies

- You may require to spend more in some areas to reduce cleaning times and create more production time

Sinners Circle
Time



- Increasing the thermal energy can reduce cleaning time
- Increased mechanical energy does not always equate to a reduction in time
- Reduced cleaning time = more production time

Carin Hagsten et al. (2019)
Removal of UHT dairy fouling — An efficient cleaning process by optimizing the rate controlling alkaline cleaning step

Production Scheduling

- Sequence production to minimise cleaning
- Allergens after non allergens
- Products with inclusions after products without inclusions etc..
- Could we limit production time between cleans to ensure faster cleaning and higher throughput of machinery ?

Where are we now ?

DO WE UNDERSTAND THE CHEMISTRY OF WHAT WE ARE DOING ?

- Mineral fouling is not affected by NaOH
- Starches have a tendency to swell into a gel like substance in the presence of NaOH
- Proteins crosslinks are cut by NaOH making them easier to remove from surfaces, however if the concentration of NaOH is too high more crosslinking can occur.

Where are we now ?

EFFICIENT & EFFECTIVE DESIGN

- Is the CIP system the most suitable?
- Are the spray devices the most suitable?
- Do we have turbulent flow conditions?
- Are we making use of the CIP set available time?
- Is it well maintained?

Where are we now ?

ARE WE CONTROLLING THE CIP PROCESS EFFICIENTLY ?

- Inverter controlled, efficient pumps
- Efficient heat exchangers
- Minimum circuit volumes
- Minimising leakage
  - £6,800 per year (1ltr/hr, 70°C, 24hrs /day)
- Insulation on heated tanks or heat when needed ?

kersia
INVENTING A FOOD SAFE WORLD

Case Study 1

WATER

- Pre rinse taken from fresh water tank not the available recovered rinse water tank
- Historical process of milk recovery from lines, not used in over a decade
- Simple change in programming
- £16,000 per year saving on water

Case Study 2

TIME / THERMAL

- Milk pasteuriser with excessive caustic cycle time
- 2024 - reduced from 4800 sec to 3600 sec
- 2025 – further reduced to 2400 sec
- Time saving of 2400 sec (40 mins) with no adverse effects

Case Study 3

TIME / CHEMICAL / WATER / CO_2

- Milk pasteuriser with unusual cleaning sequence on weekly ‘deep clean’
- Removed 25kg of Causdeta 23 / CIP (1300kg/yr)
- 1kg of caustic creates 0.625kg CO_2 to manufacture, 812.5kg CO_2 reduction
- Removal of rinse stage (720 sec)

kersia
INVENTING A FOOD SAFE WORLD

Case Study 4

WATER / EFFLUENT

- Mould washer, soft cheese producer

- Reduce water use on the disinfection / final rinse spray nozzles

- 15.5m^3 /day reduction - £24,645 / yr
  - Fresh Water £3,348 / yr
  - Effluent £21,297 / yr

Conclusion

- Depending where you are on the optimisation journey it is quite likely that there is still scope for optimisation.
- There needs to be a commitment to undertake it; it can take a long time.
- Decide on the hierarchy of objectives and tackle in order.
- Improving the performance of CIP systems **is more** than just manipulating the four cleaning parameters.
- Moreover, cleaning is not an isolated event, but integrated into the whole production cycle.
- Ensure that after a change to the system it is re-validated; consider over how long a period (days, weeks, months) this re-validation (usually 3 cleans) is carried out.
- Review the change and whether it has met the objective.

Alternatively !