Hygiene® Technologies
Smarter Cleaning Systems

Chemical application systems

What are the pros and cons?

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For many years we have been visiting New Zealand food processing plants – from plant rooms to processing rooms to ceiling spaces to changing rooms – we have seen most chemical application systems – the designs, the issues and the benefits.

From this experience we have put together this whitepaper to help you get a better understanding of the what, the how and the why.

Types of equipment – an explanation

Here's a quick look at what the different types of equipment are and the way that they work:

Central foam systems (CFS) – these systems are effectively a network of piping through which diluted cleaning or sanitising chemicals are fed. This is turned into a foam or spray at the take off point in the room to be cleaned and pumped out of a hose and applied to surfaces. The main components consist of:

Pump set – this is a booster pump which will often have a water supply tank as well if water supply is intermittent. This will boost cold, potable water up to 4-6 bar and then feed it through a dosing system. These pumps will usually have double check valves or some type of valve to prevent chemical backflow into the water supply that is compliant with the local body regulations.

Dosing system – this usually consists of a hydraulic proportional pump like this type of unit or an electric diaphragm dose pump like this. These are the means of introducing the chemical into the water stream at the set rate. They can suck out of any type of chemical container from a small container to a bulk tank, but most commonly suck out of 200 Ltr and 1,000 Ltr containers.

Piping system – this is the network of pipes that carries the mixed water and chemical media to the room or point of use where the operator needs to apply the chemical. It can simply be a main supply line that branches off to each point where chemical is needed, or it can be designed with a loop flow path or circuit so that friction pressure loss is minimised where complex pipe runs are needed.

Compressed air supply – the standard factory air supply is run through pipes or air lines to each end ofline mixer.

End of line mixers – these units simply mix compressed air with the combined water/chemical media to make it foam when it's applied to the surface being cleaned. Usually, the chemical line and air line will have ball valves to control them and the air line will often have a needle valve to adjust the flow or to 'tune' the foam mixture to the desired consistency.

Foam hoses and nozzles – this is the hose that the operator uses to access the point they wish to foam and the nozzles on the end can vary from no nozzle at all through to a fan nozzle to distribute the foam in a wide fan pattern. Some systems also have an isolation ball valve at the end of the hose to stop the foam flow without walking back to the wall

De-central foam systems
this type of system has the water piped to a unit mounted on the wall in the area that needs cleaning, along with a compressed air supply. The foaming units suck the chemical up through a venturi action, mix the water and chemical, add compressed air to this mixture and deliver the resultant foam down the foam hose onto the surface to be cleaned. These de-central units will be strategically located around the areas to be cleaned. The main components consist of:

Piping system – this is the network of pipes that carries the potable water to the room or point of use where the operator needs to apply the chemical

Compressed air supply – the standard factory air supply is run through pipes or air lines to each de-central unit.

De-central unit – these foaming units consist of a chemical venturi, a water supply and an air supply. The water and air supplies have ball valves to turn these media streams on/off and the venturi will have a suction hose with a foot valve/filter on the end which is placed into a chemical container beside/ below the unit. The venturi sucks the chemical in at the desired rate governed by either a metering tip or adjustment screw in the suction line when the water is flowing through it. Air is then injected into the chemical and water mix to make it foam when it's applied to the surface being cleaned

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Portable foaming systems

these are normally one of three different styles – an air driven foam cart, a venturi foam cart or an electric powered wash down/foaming unit. Here's a brief explanation of each:

Air driven foam cart – these are usually a roto moulded tank on a portable trolley. The operator fills the tank with mixed water and chemical at the right rate, takes the unit to the point of use and plugs in a compressed air supply through an air hose. The units have a foam hose on them which is supplied from an AODD (air operated double diaphragm) pump within the unit.

Venturi foam cart – this consists of a mobile trolley that holds up to a 20 Ltr drum of concentrated chemical which has a suction hose in it leading to a chemical venturi on the top of the cart. The operator connects a water supply hose and compressed air supply hose to the unit, switches on the valves and foam is delivered from the outlet foam hose. This works in the same way as a wall mounted de-central unit explained above.

Electric powered wash down/foaming unit – these look similar to an electric pressure washer to look at, however they work quite differently. They need a water and power supply (usually three phase) and then have an outlet hose along with an assortment of nozzles and lances. The operator can select whether they want to rinse down, foam or just spray sanitise by selecting valves or pushing buttons and some of these units will supply two operators

The pros and cons of each system

The benefits and pitfalls of the different systems mentioned above are very wide and can make a huge difference to the cleaning inputs and outcomes in terms of time taken, the amount of water and chemical used, and the actual cleaning performance of the gear.

For this reason we suggest you pay careful attention to the selection of the type of equipment you use at your plant and get good advice from someone that has your best interests at heart – we mention this because this gear is often supplied by a chemical supplier and some of them only have a small range to choose from, are locked into supplying one specific brand, or simply do not have the experience and knowledge required to suggest the best system for you. Be doubly sure you can trust the advice you act on.

Central foam systems – here's what we see are the advantages and disadvantages of the overall system when compared to other system types:

Advantages

- CFS's mean less work for the cleaners as they do not need to take chemical containers to the point of use and refill them when they run out.
- There is one chemical source and that can be outside the factory – this makes it easier for health and safety compliance with storage etc. and some overseas market rules actually stipulate there are to be no chemicals in the room while processing which gives a tick to CFS's.
- There are less chemical dilution points which decrease the likelihood of chemical dose points malfunctioning.
- Chemical application automation is easier to run off a CFS than other systems, as the piping is already running around the factor.

Disadvantages

- CFS's have a lot higher initial install cost than other systems due to the system components and installation required.
- You can only use one chemical per piping network, meaning if you need two or three main chemicals for your factory, you need two or three systems installed.
- Chemical (especially chlorinated variants) tends to degrade in the pipework when the system is not being used – especially in higher temperatures in summer where pipe systems are running through roof spaces. This means that until the piping network contents are used up during the next clean, the cleaning/sanitising effect may be worse than expected.
- If the chemical dosing or pumping equipment malfunctions or the chemical runs out, all the cleaners get poor performance, or at worst no chemical – not just one outlet in the plant like a de-central system.

CFS dosing pump options:

Dosatron units

Advantages

- These units are a lower cost than using an electric dose pump for the initial set up
- Relatively easy to set up and remove for maintenance and setting dose percentage
- We can source an aftermarket non return valve for the base of these units which significantly reduces the seal wear and increases reliability

Disadvantages

- The maintenance requirements for these units are more frequent than an electric dose pump, which usually means that most sites have a back up unit in place so one can be serviced while the system remains operational
- This type of dosing is a lot less accurate than an electric dose pump due to the design of the system. When seals wear the dosing loses accuracy and we have seen evidence of actual dosing being up to 2% below set point
- These units do not like trying to suck when a valve is closed on the suction line – major damage can be caused to the unit if an operator closes a valve by mistake or a suction hose seals shut

Mixrite units

Advantages

- These are the same as the Dosatron units above (except the point about the aftermarket valve), with the addition of the following
- These units are a significantly lower cost than the Dosatron brand, however the units commercially available in NZ/Australia are limited to smaller sizes than the larger Dosatron units

Electric dose pumps

Advantages

- A lot more accurate chemical dosing than the two previous units
- These dose pumps mix the chemical and water better than a hydraulic proportional pump, however this is not usually an issue unless you have outlets close to the pump outlet
- Dose pumps can inject chemical at a higher pressure which gives the option of a boosted pressure CFS which can significantly reduce the volume of chemical and water used per minute by each operator

Disadvantages

- Electric dose pumps usually have a much higher initial cost than hydraulic proportional pumps due to the equipment cost, installation cost and the other components needed in the system to make them work effectively

Piping

These are not pros and cons – just some comments you should be aware of:

- Design – this is very important for two reasons – one to reduce maintenance costs and the other to give the cleaners proper foam performance at the end of the system. What we mean by design is correct pipe sizing for minimal friction loss, correct design around bends and tee's, adequate venting at correct locations, correct pipe material for long life and pipe support design
- Material – the key thing here is to make sure the manufacturer or NZ agent for the piping system you wish to install will guarantee the material for the chemicals you wish to use in it. This will cut all the cheap pipe systems out of the picture that we see used too many times in the industry. The result is that less than five years later the system starts developing leaks, then when the engineers get sick of repairing it, the whole pipe system gets replaced. The irony of this is that if the correct material is installed in the first place, the lifetime cost is substantially less than the using the wrong material
- Stainless steel piping – do NOT use this for chlorinated chemicals, apart from vertical only runs at the end of the pipe runs. If you do, it will corrode and will need replacing. There is a technical reason for this which we won't go into here, but we just want to warn you about this
- PVC (or CPVC) Schedule 80 piping – in our experience, this is the best product for chlorinated detergents, however this comes with the proviso that good design is also taken into account as per the comments above
- Heat fused polypropylene water piping – do NOT be tempted to use this. A number of chemical companies suggest this because it is inexpensive and relatively quick to install. Everywhere we go we see issues and problems with this – it simply is not worth it when you look at the lifetime cost of the system

End of line mixers

Low pressure mixers (up to 6 bar liquid pressure):

- Comments - a number of engineers believe these are just simple tees for mixing liquid with air, so they make their own and are then stuck with poor foam performance from then on. Don't make your own – there is a science to design and orifice sizes that is very specific to make a good foam – pay slightly more and get one that works properly from a reputable source

Boosted pressure mixers

(up to 10 bar liquid pressure):

Advantages

- These units go through a lot less chemical and water than their low-pressure counterparts which is an obvious benefit
- The performance of these mixers is much less susceptible to being upset by multiple users than low pressure mixers

Disadvantages

- These units usually have an air regulator fitted in the air supply line within the mixer which has more moving parts and maintenance requirements than the simple needle valve air adjustment of a low-pressure mixer. We do however find in reality that we rarely need to maintain the regulators in these mixers – they are very reliable
- Not all piping systems can handle being upgraded to 10 bar as the piping materials are not rated to it or the pipe condition is fragile due to age or chemical damage

Hoses

- Comments – a number of NZ companies sell hosing that is rated for the correct media pressure, yet the liners and covers are made of PVC. In theory these are OK for most chemicals, however in practice they wear very quickly and need replacing. They are also quite stiff and hard to bend in colder temperatures which a lot of food processing factories need to work in for food safety or to meet regulations. Make sure the hose liner and cover is a type of synthetic rubber – not PVC – and always use stainless steel hose tails and crimp collars rather than zinc plated steel options. It's a good idea to have an antimicrobial feature to the outer cover to protect against microbes in cuts in the outer surface and make sure the cover is resistant to animal fats

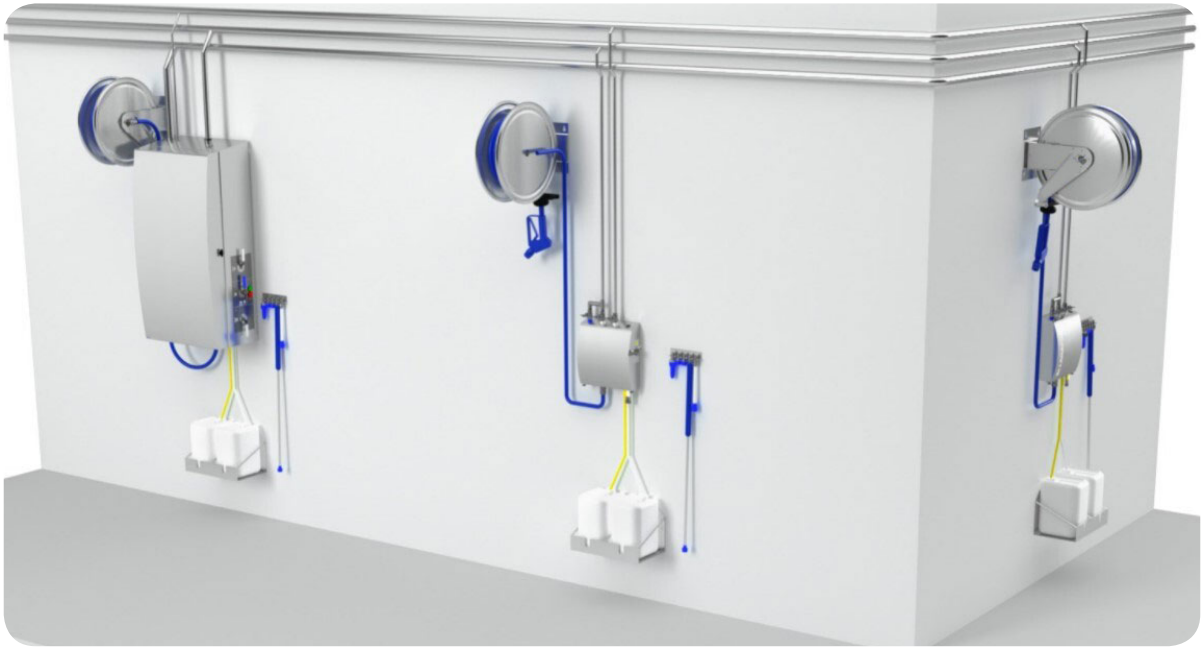
De-central foam systems – here's what we see are the advantages and disadvantages of the overall system when compared to other system types:

Advantages

- The initial install costs of a de-central system are usually a lot lower than a CFS, as it really consists mainly of satellite units fitted to existing potable water outlets at strategic locations
- These systems can run multiple chemicals at each station and each station can run different chemicals. This gives you flexibility to have specific products for specific areas which ultimately gives you better outcomes
- There is no chemical running through the media supply lines meaning chemical applied is fresh and eliminating corrosion issues in the pipe systems
- If any particular dose point malfunctions there are usually other ones that can be used to fill in while it is repaired. This is an advantage over a central system where the whole system falls over if there is a dosing malfunction

Disadvantages

- Every time the chemical container runs out at a specific station it needs to be refilled or replaced. Efficient systems for doing this can be set up, however you can not get away from the fact the replacement is needed which is not as efficient as a central system
- Concentrate chemicals will be located right across the processing area of the site when cleaning is in progress, which in one aspect increases health and safety risks (there are systems which mitigate these risks substantially). Some overseas market rules stipulate there are to be no chemicals in the room while processing which means the containers will need to be stored outside the process area during production
- As there are a lot more chemical dilution points than a CFS, the likelihood of chemical dose points malfunctioning is higher



Decanting system options:

Manual drum pumping

Advantages

- Pretty much the only advantage of this system is the relatively low set up cost for the equipment – a drum pump made from compatible materials, standard chemical containers and the associated PPE gear required

Disadvantages

- The biggest disadvantage of this system is the health and safety risk of manually decanting concentrate chemicals. There are many potential contact points for operators to come into contact with these chemicals from incorrectly worn or failed PPE right through to not paying attention to what you are doing and spilling product. We have witnessed numbers of nasty results from chemical burn injuries which are often due to labels that are not fit for purpose and unlabelled containers scattered around factories. Often the drum pumps do not screw into the drums correctly making them awkward and dangerous to use

- Another big disadvantage is the wastage that can and does occur when cleaners have access to concentrate chemicals. Often food factory cleaning operations are under time pressure, as production must start on time, but when it runs overtime at the end of a shift, it is always the cleaning time slot that gets shortened. For this reason, the cleaning team are looking for anything that could potentially speed up the process and a common misconception is that stronger chemicals work faster which is often not the case. This leads to using chemicals too strong causing wastage and often making surfaces harder to rinse

- While speaking of time, another disadvantage is the time taken to manually decant into smaller containers, is much more than with automated methods of doing the same thing. Add to this cleaners potentially standing around waiting for their chemical container to take to the factory and the costs really start mounting

Closed loop systems

Advantages

- These systems keep operators away from concentrate chemicals (in theory, as some of them are easy to bypass and still access the concentrate chemicals)
- The better systems of this type allow you to buy the chemical concentrates in larger pack sizes such as 200 Ltr or 1,000 Ltr drums, which means you can enjoy the benefits of lower costs per litre and the containers have
- proper chemical resistant colour coded labels to make sure the operator always knows the contents

Disadvantages

- Some of these systems you must buy the chemical in small non-refillable packs, adding to chemical costs
- The initial set up of these systems will cost more than setting up a manual drum pump

Satellite units

Comments – there are many varied brands of these, with quite diverse operating principles, designs and layouts. Pay attention to the mixed media flow rates at different pressures, as this will make a huge difference to your chemical bill and cleaning water consumption – you should aim for 10 Ltrs/min as a guide. Our advice with these units is keep them as simple as possible with regard to design and built robustly for long life and minimal maintenance. We have seen some horror stories in the industry with all sorts of fancy features such as air-controlled selector valves and large streamlined cabinets with little content – steer away from these and go simple every time. The only components necessary are:

- Air isolation valve
- Water isolation valve
- Air tuning valve
- Robust venturi
- Chemical selector valve if more than one pick up with simple dose adjustment (this is an advantage over CFS's as you can have multiple chemical and concentration options)
- Flush/foam valve if unit is to rinse as well

Hoses

Please see hose section above for central foam systems

Portable foaming systems

the obvious main advantage of all portable systems is the lower initial cost without capital work such as piping needing to be done. The main disadvantage is that every time the system is to be used, it needs taking to the use area, setting up and plugging into the media. Then once the chemical runs out it needs refilling before the operator can carry on and at the end of clean the unit needs cleaning and packing up. There are a number of different types – we will look at the main ones now:

Air driven foam cart

these consist effectively of a tank which is filled with water and chemical mixed at the right rate, an air supply fitting which is connected to a compressed air supply and a foam hose to apply the foam

Advantages

- These units only need one compressed air hose to run them, making operation fairly simple
- They foam well irrespective of factory water pressure
- Some makes are made very robustly of roto-moulded plastic and stainless steel to withstand the knocks and bangs of food factory cleaning

Disadvantages

- The unit needs to be filled with water and chemical, refilled when it runs out and then drained if a different chemical is required. There are dosing units available however to automatically mix the chemical with the water when filling to avoid chemical burns and wastage
- The air driven pumps are very susceptible to any moisture in the compressed air line – if your air supply travels a long distance through cold piping or has any element of moisture in it, we suggest you add a proper air filter in the air supply line – a standard water trap is not sufficient

Portable venturi cart

usually a stainless-steel trolley that takes a 20 litre chemical drum of concentrate chemical that feeds a dose adjustable venturi. A cold potable water hose is connected to the unit along with a compressed air line, which feeds the foam hose on the unit

Advantages

- You can foam a greater area with these units than the air driven foam cart, as you have 20 litres of concentrate chemical to use up
- The chemical is mixed automatically with the water saving the user a job

Disadvantages

- As the dilution happens on the unit, differing water supply pressures and suction leaks can change chemical percentages meaning performance may vary
- There are two media sources to connect - water and air – rather than just air on the air driven foam cart. The water supply hoses are often long and end up coiled up beside the cart creating an additional trip hazard and means another cleaner cannot use that hose for rinsing while it is supplying the foamer

Portable medium pressure unit

These are more than just a chemical application system – they rinse with medium pressure water (20-40 bar), they foam with an onboard air compressor and they sanitise without compressed air. You need to supply them with water and three phase power and they have an outlet hose – usually about 20 metres in length with an assortment of spray and foam nozzles. They can suck either one or two concentrate chemicals based on whether you want to just clean or clean and sanitise separately and dilute them through a venturi. Some models will supply enough volume for two operators.

Advantages

- These are more than just a foamer – they are a complete cleaning tool that foams, sanitises and rinses down with medium pressure. This gives an operator something that they can use for cleaning surfaces, or to run automated cleaning units such as belt or chute cleaner

Disadvantages

- You need both a power and water source to run these units
- Please be aware that some brands whilst they look smart in terms of aesthetic design, have several plastic and light sheet metal components which in practical use get damaged and broken – this is costly for maintenance, so make sure you talk to users of the brand you are looking at buying before committing to anything

The winning combination – what works best together?

There are many, many different situations out there amongst NZ food factories and many different constraints – some are water supply issues, some cleaning time pressures, some physical access to surfaces, some health and safety problems and some are unrealistic customer requests. For this reason, we want to add a big disclaimer to the following recommendations that you get your situation thoroughly searched out with a cleaning specialist you can trust, to make sure you get the best option for you.

We believe if you look at the lifetime cost of installing, maintaining and operating a chemical dilution and application system, that you will get the safest system for your operators, the best return on your investment and the most flexibility for future needs by this combination:

1. A closed loop decanting system that allows you to take chemicals from either 200 Ltr drums or 1,000 Ltr IBC's and transfer them to 10 Ltr containers that are clearly labelled with chemical resistant, colour coded labels. A mandatory requirement of the system is that no operator under any circumstance should have access or be able to touch concentrated chemical

2. A water supply pump that has excess capacity above what is required for cleaning right now. This allows for future expansion and automation potential without having to upgrade the whole system

3. Stainless steel press-fit piping running to strategic satellite locations with cold potable water along with warm water (if required) at a temperature suitable for the soil type in your facility

4. Simple de-central satellite stations with foam/flush valves and the relevant number of chemicals required for your situation

5. Good quality hoses (no longer than 30 metres) with quick coupling fittings and relevant spray nozzle selection

6. Strategic cleaning automation custom designed for specific cleaning tasks in your plant where a good return on investment is gained over manual cleaning, or other health and safety benefits are gained

Where to from here?

It's a minefield out there when it comes to where to start with the right system for your situation. The most important step as we stated before is to find a specialist with a lot of experience with helping food factories with the best cleaning answers to customers challenges – the company should have both chemical and engineering expertise and above all, ask them some difficult questions to be sure you can trust their advice – at the end of the day, getting this decision wrong is a very costly and frustrating option.

Make sure you can get some guarantee's that the system they suggest will give you the outcome you are looking for and lastly – make sure the system is future proofed by being flexible and adaptable – you want to make sure you can take advantage of future innovations that enter this space.

One last bit of advice – some chemical companies try and make their offer of free-on-loan gear very attractive to you and with the way they present it, it does look attractive on the surface. Unfortunately, in life there are not really any free lunches – if you look at the real value you receive over the term of the contract you need to sign to take advantage of the offer, you may be disappointed. We are not saying that all free-on-loan deals are bad value, but just warning you to be wary of them – often the savings you can achieve over three to five years through smart systems, processes, training and continuous improvement will far outweigh the capital cost of a chemical dosing and application system.

If you would like some help from our Solutions Team on how to start your smart journey towards these benefits, please email solutions@hygienetech.co.nz or reach out to us on 0800 732 525