THE WASHUP – WHICH INDUSTRIES ARE REALLY LEADING THE WAY IN WATER EFFICIENT CLEANING?

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ABSTRACT

The culture and expectation of how cleaning is approached varies widely between industries, and the increasing trends in monitoring and auditing water use are starting to highlight these variations.

There are a number of trends that have become apparent when comparing the water efficiency of cleaning. When combined with technological advances, opportunites can be identified for expanding efficient practices into different areas and industries.

For many sites and utilities, this means a small adjustment in their approach to cleaning could dramatically reduce overall water use.

INTRODUCTION

Water used in cleaning is one of the key water use areas on the majority of commercial sites, and different sites and industries show a wide variety of technical and management-related approaches.

Why is it that vast public areas in shopping centres are cleaned with negligible quantities, while floor hosedown can account for the majority of water bills on small manufacturing sites?

How is it that the daily cleaning of amenities through a large hospital can use less than the daily cleaning of a small pool deck?

Through information gleaned from continuous remote monitoring of water meters in a variety of different projects in Sydney, this paper will draw together some general impressions about water used for floor and surface cleaning.

Clean-In-Place (CIP) systems installed in custom designed manufacturing plant equipment and dishwasher/glasswasher units are not considered in this discussion, as the water use of these is typically controlled by individual manufacturers, rather than site users and managers.

But there are some principles that can be generalised about water used for rinsing floors, pool decks, cars, trucks, toilets areas, conveyors, mixing tanks cooking pots, trays, animal enclosures, tables and other similar surfaces.

These will be discussed along with barriers and opportunities for water efficiency – the latter of which were generally found to be very cost effective.

ORIGIN OF OBSERVATIONS AND MONITORED DATA

The observations and flow monitoring data were generated through water efficiency audits of commercial and industrial sites, pilot trial studies of low flow spray guns, and water checks of various carwash facilities in Sydney.

The data is gleaned from mechanical water meters attached to data loggers that average pulses (at 5 or 10 litres per pulse), averaged over 5 minute periods. This data format focuses on the flowrate of constant use and total volumes, rather than transient peaks and short water use events.

An example of the equipment used is provided as Figure 1.

Figure 1 – Typical Meter and Logger Used for Flow Data Capture.

The logger sends data to an online server via the next G network, allowing temporary wireless installation on existing main meters, and on individual hosetaps on commercial sites.

Other data was gathered using personal surveys of operators and cleaners about their cleaning practices and impressions of changing their processes to make use of lower flow devices.

THE SCOPE OF THIS PAPER

There can be a large number of relatively disconnected observations drawn about specific industries, sites and even particular users of water on commercial sites. But the purpose of this paper is to draw together wider principles that have been found to be water efficient in particular industries or sectors.

In many cases, these principles are found to relate more to the history or culture of the work than to any technical requirements. Then combined with technology change, there is the opportunity for expansion of ideas and principles into areas and industries where these principles have not yet been trialed or considered.

GENERAL PRINCIPLES OF CLEANING RELATING TO WATER EFFICIENCY

Flowrate

The amount of water used per unit of time spent cleaning obviously has a very significant affect on the amount of water used.

An operator or kitchen hand rinsing down with open hose providing a laminar flow could 2 to 20 times the water used by a nearby staff member with a different orifice on a similar hose.

An example is a catering kitchen in an entertainment facility. This had a number of hosepoints – one was a spray gun with a 15L/min flowrate, and another was an open hose with a 36L/min flowrate for the same purpose.

Figure 2 – Open hose and Spray Nozzle in the same room

It is often not easy to tell the flowrate without measurement, but the vast majority of fittings in all industries are above 20L/min – higher than average showers.

Frequency and Duration

More critical to overall water use, however, is the frequency of use – how many minutes per day water is flowing for cleaning purposes.

This is directly related to the roles and responsibilities of site staff – those who only have the job of keeping things clean (and little else to do) can spend much of the day wandering with a hose. Sites where cleaning is done externally or one of many other responsibilities can dramatically reduce the frequency and duration of use.

Frequency and duration are often influenced by technical and time factors also. A busy kitchenhand does not have time to turn off a tap every time they are finished with rinsing a pot or bench – and this may lead to hoses left running for significant durations compared to the actual use requirement.

A line operator (on the other hand) may need to sufficiently clean a tank or bay area before a product switch or shift change, and in this case a short duration is the single greatest priority.

These factors were found to create situations where a high flow fixture on a large (pressure boosted) manufacturing site used significantly less than a kitchen or pool facility. For example the manufacturing site profile below shows similar flowrates to the kitchen profile, but the frequency of use leads to the kitchen using 10 times the water used on the manufacturing site through a similar hose. The profiles also show the effect on overall usage of a lower flow fitting, which was much more significant in the kitchen.

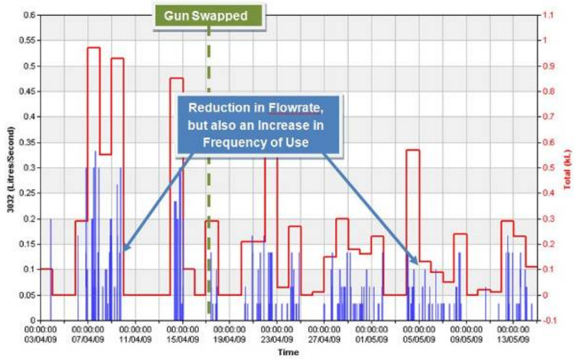

Figure 3 – Manufacturing hose profile

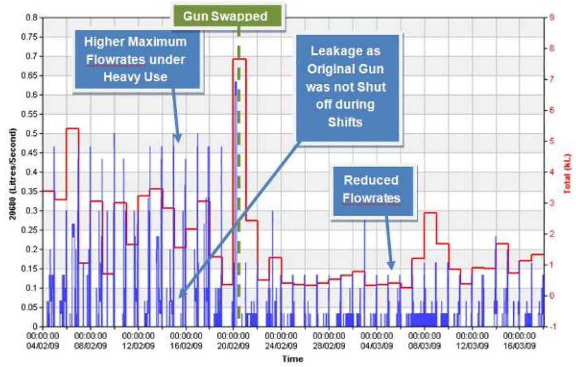

Figure 4 – Kitchen hose profile

Limiting the time of both deliberate and accidental use was therefore found to have the largest effect on reducing water used for cleaning on all sites.

Hands-on vs Hosing

Analysis of competing car wash sites has highlighted the benefits of human effort in the cleaning process.

The carwash sites where staff were employed to wash and high-pressure rinse vehicles by hand were found to use approximately 57 litres per wash, vs 168 litres per wash for automatic systems.

This was attributed to the targeting of the water spray to the most affected areas, and the use of soapy sponges to remove stuck dirt (in a single swipe) rather than water force gradually dislodging over the whole car surface.

Automatic washes were found to be the least efficient, despite the ability to use reuse water – as the water jets for a standard wash needed to be calibrated for a 'worst case' dirty car scenario – rather than simply washing until the car is clean.

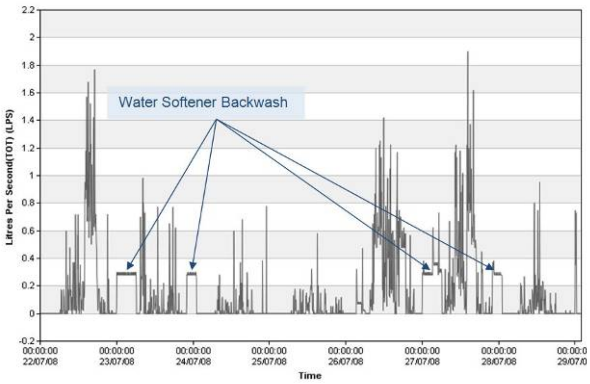

Figure 5 – Automatic Car Wash Monitoring – higher flowrates and extra plant usage

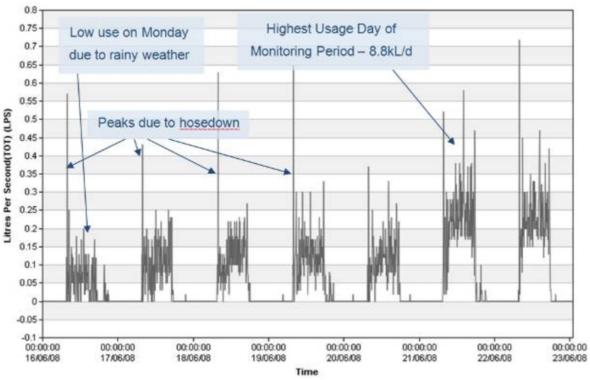

Figure 6 – Hand Washing Monitoring – lower flowrates, high car numbers of water used

This same principle was found to apply in kitchen and on floors in manufacturing sites.

The Affect of Public Areas Safety

Large shopping centres generally use a small amount of water to clean a very large area – through tank filled floor cleaning units.

While this is partially due to a lower loading of oil and grease on these surfaces, the driver for such low water use is a safety related issue – an aversion to pooling on wet floors. The lack of moisture reduces the risk of slips and falls, which ensures the centre is better covered against injury claims.

Conversely, pools are expected to be wet, and are designed with surfaces that will retain maximum grip even when wet. This has the double effect of allowing constant hosing of the deck and floors during all times of day, and making the removal of debris with a hose more difficult (due to the rougher surface designed for grip).

For this reason, excessive hosing is common at pool sites, but not in shopping centre public areas.

Following Existing Procedures

Many manufacturing sites have existing procedures in place, and may already have the main floor stocked with brooms, squeegees, scoops and bins to allow solid waste to be quickly removed by solid objects (leaving the water use for a rinse of sticky or small remnants).

These are excellent solutions and would make a strong difference to water use if they were not so regularly ignored by operators (preferring the simplicity of hosing everything down). Figure 7 shows a site operator attempting to move a large amount of broken glass out from under a machine using a hose.

Figure 7 - Site operator hosing broken glass bottles from under equipment

Enforcing rules throughout the site would dramatically reduce duration of water use, and at the same time reduce time taken and the effectiveness of the clean.

The Impression of Pressure

Surveys of operators and cleaners in a variety of industries indicated that 'pressure' is a subjective concept.

Swapping fixtures does not reduce water pressure, but the water flow – which can influence the force and inertia of water as it moves through the air and impacts a surface.

Users preferring higher flow for their cleaning were found to refer to 'better pressure' when they observed more of a 'kick back' effect from a hose being turned on, and more capacity for extra water to 'float' debris to drains. Neither of these attributes influence the ability for a water spray to rinse a surface free of residue – this is affected by the force at the surface point. This force is dependant on nozzle design more than water volume.

It was therefore identified that a barrier to water efficient practice was a misunderstanding about water pressure, and skepticism about the ability for effective cleaning with lower flowrates.

There were examples recorded of hospital, manufacturing, kitchen and animal care sites that found significantly lower flow fixtures more effective at cleaning after a brief trial. But the initial reaction is most commonly skeptical.

Figure 8 - New spray gun of flowrate 12L/min 'cleans much better' than old gun with flowrate 30L/min at 800kPa

<u>HELPFUL TECHNOLOGICAL ADVANCES</u>

The development of a variety of technologies in recent years as opened up possibilities for cleaning to be done to a higher standard using less water.

Nozzle Design

Spray nozzles disrupt the laminar flow of water, and use the pressure force to introduce turbulence and aeration. This encourages smaller volumes of water to exit at significantly higher velocities.

Nozzles are used for a variety of purposes, but in regard to commercial cleaning, variable pattern spray guns and pre-rinse spray valves allow rinsing and hosing of small solids to be done with less water and more force. Variable patterns provide versatility – allowing the same unit to provide a wide mist and a focused zero degree jet.

Nozzles are particularly effective with higher pressures – high pressure cleaners (with booster pumps) allow very high water forces with flowrates comparable to an efficient basin tap.

Figure 9 – A Low Flow Spray Gun 'wide' pattern

Long Handles

One difficulty with lower flowrate devices is that the lower volumes of water have less inertia. This can cause a spray to disperse or 'mist' if long distance spraying is required.

More manufacturers are now taking this into account, offering lance options to extend the gun length and put the nozzle closer to the surface. This can dramatically improve effectiveness and ergonomics of use.

Another new adaptation of this is the 'waterbroom' – currently available in the USA. This has a broom like shape, but instead of bristles there are a number of low flow nozzles very close to the floor surface.

This design allows fast and low flow cleaning of large surfaces, and the units are already part of rebate programs in some water utilities.

Figure 10 – 'Watermiser' Water Broom

Automatic Shutoff

With duration of usage being such a critical factor in the total water used, it is important that water is only flowing when it is used. Automatic shutoff is useful in ensuring that even in the case of a busy workplace or a careless operator, leakage or continual flow is avoided.

Sites where fixtures are left running or leaks are common can use large volumes without noticing – automatic shutoff valves in spray gun triggers and timed tap valves can provide a technical solution without significant change to practices.

Alternate Force

The improvement of other non-water cleaning tools is another area for consideration.

Air pressure can be useful for outdoor areas (as with leaf blowers), as wetting some solids like leaves and dust can make cleaning more difficult. Removing them dry with air can be quicker and more efficient.

Also, the development of ergonomic and effective broom and hand scrubber products is progressing. In most cases, these are significantly more effective than using water only to clean large solid or 'caked' waste. Improvements to these products allow them to be correctly specified to a particular task – allowing operators to use these tools more efficiently, and encouraging the continued use of these more effective methods.

Alternate water supplies

Automatic cleaning equipment has been making use of internal recirculation for some time – many commercial dishwashers and washing machines allow reuse of final rinse water for initial rinse.

But on a larger scale, a similar opportunity exists on many sites – to make use of relatively clean water from cooling jackets, rainwater tanks or another nearby process in pre rinsing, cleaning of floors, and hosing outdoor areas. As the costs for basic water treatment continues to fall, more streams of single-use water can become available for a 'second use'.

OPPORTUNITIES IDENTIFIED

The comparison of cleaning in different industries, combined with the influence of technology, creates a large number of variables and influencing factors. The following opportunities have been identified as common principles that can be applied across a relatively large proportion of the industry to reduce the water used for cleaning.

Scrubbing and Soaking

In residential homes, car washes and kitchens, it is common practice to use soaking and scrubbing to remove solid, heavy, sticky, greasy or 'caked' waste from vessels, tools or equipment.

But on larger manufacturing, educational, health and animal care sites, the culture or available equipment only lends it to an operator continually hosing from a significant distance. This is not only water inefficient (requiring large flowrates and long durations), the cleaning effect tends to be less effective and slower.

The implementation of procedures for basic soaking, followed by a manual clean (with well-maintained and effective manual tools) is expected to save time, money and water on many 'hose reliant' sites.

Brooms and Floor Cleaners

A similar principle applied to floors, encouraging manual use of brooms and dedicated floor scrubbing units, allows much more targeted surface cleaning.

This is uncommon in health areas, kitchens and workshops where younger staff or cleaners are expected to hose down the entire facility once or more per day – again as part of the culture.

The use of these alternate tools also reduces the likelihood of staff 'killing time' with unnecessary cleaning – as is common with hosing.

Proximity

When hoses are used, it is important that operators are as close to the surface as possible.

Both large manufacturing sites and relatively compact kitchens often have sparse hosepoints and relatively short hose lengths – encouraging staff to spray long distances.

Longer hoses, more hosepoints, extensions on spray nozzles, the use of central cleaning bays, and improved accessibility to all floor areas can allow more effective hosing – even with significantly less water used.

The washing of cars, trucks, and conveyors are normally done with suitable proximity, but floors, tanks and enclosures are typically cleaned from long distances.

Properly specified flow nozzles

There is a significant opportunity for saving water with appropriately selected spray nozzles, as these become more common in smaller businesses.

The use of open hoses is common in hospitality and smaller commercial industries. This is usually relatively ineffective and wasteful, while nozzles would allow faster, better and more efficient cleaning.

One key barrier is the selection of appropriate nozzles, as there are a large number of patterns orifice sizes and types – affecting flowrate and practicality.

For light wetting of glass and vehicle rinsing, a wide light spray is most effective. For heavy solid waste a straight and powerful jet is required. Some products provide a variable spray pattern, and this was found to be a common reason for acceptance from site operators. This is attributed to the fact that many small businesses use the same hose for cleaning a varitey of surfaces (such as in a mechanic's workshop).

Brooms to clean under benches or equipment

It is common in kitchen and manufacturing areas for areas under equipment to be cleaned with an operator spraying a hose from a distance – even when cleaning heavy solid waste. In many cases, this is the single reason why a very high hose flowrate is used in a large area.

An opportunity exists for the introduction of ergonomically appropriate brooms with a long reach length to remove solid waste from under tables and equipment.

Consideration for Surfaces

The selection of floor surfaces was found to make a significant difference to the cleaning conducted on the site.

Floors designed to provide grip when wet are particularly difficult to clean. In most cases, a large amount of water will be required to flood and 'float' debris away. Most attempts to use normal blasting force will encourage waste to grip the floor and inconveniently break up into smaller pieces.

More careful placement of high-traction surfaces and drains can therefore lead to improved cleaning efficiency.

On sites with rough floors already installed, dry blowing, close proximity and scrubbing tools are all recommended to clean more efficiently than water 'flooding'.

Managing Personal Impressions

Though many site users were found to have an in-built skepticism regarding lower flow devices, it was noted that this was often overcome if they were able to test a device in their own workplace.

The majority of users noting a lower flow going to drain are uneasy about swapping from existing fittings – for fear of inconvenience and lower time efficiency. Enforcing a trial period was found to allow the psychological barrier to be overcome – with many sites developing an acceptance or even a preference for lower flow units within days.

A critical factor is allowing the devices to be tested in the workplace. The average immediate user rating after trying a new low-flow fitting in their own workplace was 8.1 out of 10 – compared with 5.1 out of 10 for their higher flow existing fittings.

This shows that many barriers to lower flow are more related to personal impressions and fears than technical issues – and the opportunity for wider adoption of more efficient devices exists.

DISCLAIMER AND FUTURE DEVELOPMENT

There is still much to be learned about the efficiency of cleaning – flow data is currently only analysed on a small scale as part of studies with other focus areas, and this paper has only touched on the psychological elements, variations between sites within industries, and applicability of new technology.

There are also considerations for the impact of the use of hot water and pumps on energy use, and the downstream health and wastewater impacts of chemicals and solids loading.

The further development of these specific areas is expected to generate more cost effective opportunities for reducing resource use while maintaining and improving hygiene.

CONCLUSION

The consideration of water efficiency in cleaning remains a relatively new concept – particularly in the approach to cleaning practices across different industries.

It has been possible to identify some general opportunities from flow and survey data in a range of workplaces.

The further development of these and other opportunities identified (as water used for cleaning starts to be accurately measured) have the potential to significantly reduce water on a variety of sites.