WATER EFFICIENT PROCESSING – W2

Eco-efficiency resources for the food processing industry

Reducing demand for water in processing

Food processors can use significant amounts of water to process their products. Often this high water use is viewed as just a necessary component of producing food.

However, opportunities exist to significantly reduce water use, ranging from low-cost modifications to existing process operations, to replacement of old, inefficient equipment with water-efficient alternatives.

Some simple ways to make processes more water efficient include:

- using mechanical or pneumatic transport instead of water conveying
- blanching with steam rather than water, to reduce water, trade waste and energy costs, with the additional benefit of retaining nutrients in the food
- optimising the design and operation of packaging lines to reduce product loss and cleaning requirements.

REDUCING WATER USE BY 52 PER CENT THROUGH CHANGES IN PRACTICES

Food processing company, Australian Food Corporation, reduced their water consumption from 3.10 kL per tonne of product to 1.49 kL per tonne of product over three years through a series of changes to water practices in the factory, including:

- replacing all inefficient taps saving 296 kL/year
- reducing the defrosting cycle of freezers saving 5,500 kL/ year
- turning off sprays when the conveyor was not running saving 13 kL/year
- replacing interlocking belts with flat belts saving cleaning time and 788 kL/year
- retraining staff to operate hoses more effectively and to preferably dry clean or use buckets to wash spills on floors during manufacturing.

(Australian Food Corporation is an ecoBiz participant)

Optimising water flow rate

Water can be wasted if equipment is operated at water pressures or flowrates higher than required. To determine if flow rates can be reduced, compare current flow rates with the manufacturer's specifications and food safety requirements.

Additionally, trials to determine optimum flow rates can be undertaken. Flow regulators can be installed to maintain the optimum flow rate with access to valves restricted using locks to prevent alteration.

CONTROLS ON KNIFE STERILISER

Prepared Foods, a supplier of pre-prepared foods and value added products, adjusted the flow rate to a small knife steriliser in the meat preparation room to the minimum flow rate required for food safety. The handle to the flow control was also removed to prevent staff adjusting the rate. The steriliser was previously left on continuously but is now switched off during non-production hours. The initiative saves 55 kL a year. (Prepared Foods is an ecoBiz participant.)

Control water flows

Water sprays are often used in food processing for washing or to lubricate equipment. Continuous water sprays left running unnecessarily during breaks in production should be avoided. Linking sprays to conveyor or equipment motors using automatic cut-off switches can help eliminate water wastage.

Monitoring and process control devices

Installing automatic monitoring and control devices in key sites can lower production costs. Many devices are available to measure level, flow, temperature, pH, conductivity, pressure and turbidity. For example, pressure sensors on filters can initiate cleaning only when necessary and level control sensors on tanks can prevent water and product overflowing to the drain.

It is essential that process controls are regularly checked to ensure they have the right settings and are correctly calibrated.

Prompt repair of leaks

Leaking equipment such as pumps, valves and hoses should be repaired promptly. Leaks that are not fixed quickly can waste significant amounts of water as Table 1 below illustrates.

Table 1: Water loss from leaks[1]

Speed of leak	Water loss per year (kL/year)
Slow drip	20
¾ mm leak	227
1 ½ mm leak	896
3 mm leak	3,473

Below are some tips on leak management.

- Establish a system to monitor, report, record and fix leaks promptly.
- Install meters on equipment that use large quantities of water to identify leaks promptly.
- Compare water use with the equipment design specifications.
- Ensure that flow meters are calibrated appropriately.
- Review trends in water consumption.
- If possible undertake a ‘zero-flow’ audit during a period the factory is not in operation to determine if there are any hidden leaks.

1 The University of Queensland, Don’t be a drip poster, www.pf.uq.edu.au/Ems/pbs_DntBeDrpPstr.pdf

REPLACING A LEAKING PUMP SEAL

Prepared Foods, a supplier of pre-prepared foods and value-added products, replaced a leaking seal, running at four drops a second, on a pump in the plant room, saving 17.5 kL of water per year.

If 10 similar leaks are repaired every year, this is a saving of $420 in water cost alone. (Prepared Foods is an ecoBiz participant.)

Use efficient spray nozzles

Water spray nozzles are used for purposes such as cleaning, conveyor lubrication or cooling heated product. Water savings can be made by reviewing spray and jet technology that allows for reduced water use without compromising spray effectiveness.

Spray pattern, flow rate, placement, alignment, flow pressure and drop size should all be considered when selecting nozzles, as appropriate selection can provide significant water-saving opportunities at low cost.

The durability of the nozzle should also be considered as water consumption increases with nozzle wear. For example an aluminium nozzle with an abrasion resistance ratio of one has a flow increase of 26 per cent from wear after 50 hours of use, compared with a hardened stainless steel nozzle that has a ratio of 10–15 but has a flow increase of only one per cent after 50 hours.[2] Table 2 provides examples of different nozzle materials and the range of corresponding abrasion resistance ratios.

Table 2: Comparisons of different nozzle materials[3]

Material	Abrasion Resistance Ratio
Aluminium	1
Brass	1
Polypropylene	1–2
Steel	1.5 – 2
MONEL	2–3
Stainless Steel	4–6
HASTELLOY	4–6
Hardened Stainless Steel	10–15
Stellite	10–15
Silicon Carbide (Nitride Bonded)	90–130
Ceramics	90–200
Carbides	180–250
Synthetic Ruby or Sapphire	600–2,000

Regular monitoring and maintenance of nozzles will increase performance, as worn or heavily scaled nozzles are inefficient. While ceramic nozzles are a more durable options (lasting 10 times longer than stainless steel), they can crack if dropped or over tightened.[4]

Opportunities to reuse water through nozzles have also become more viable in recent years, with improved nozzles better equipped to tolerate dirtier water without blocking. Using relatively pure recycled water can reduce nozzle maintenance requirements.

2 Spray Systems Co., 2008, www.spray.com and Teejet, 2008, www.teejet.com/english/home.aspx
3 Spray Systems Co., no date, Technical Reference, www.spray.com/cat70/a/Cat70_Section_A.pdf
4 Government of British Columbia, 2000, Take Care of Your Sprayer Nozzles, Tree Fruit & Grape Industry News www.agf.gov.bc.ca/treefrt/newslett/sprayer_nozzles.htm

NOZZLE EFFICIENCY IMPROVED THROUGH USING REVERSE OSMOSIS WATER

Foster's Australia, a brewery, have increased the efficiency of nozzles by treating incoming reticulated water using reverse osmosis (RO). The high quality of the water produced by RO has reduced scaling of nozzles allowing smaller nozzles to be used, saving water and reduced maintenance requirements.

For more information visit: Spraying Systems Co., 2003, Optimising your spray system, www.spray.com/services/edu_ref.asp

Reduced hose sizes

Reducing the size of cleaning hoses can reduce flow rate and water use. However, if the hose is used to fill a volume, e.g. addition to product, reducing the size will increase the time required to fill the volume. Automatic hose reel up systems can be used to protect the hose from damage.

SIMPLE PROJECT PROVIDES SAVINGS

Prepared Foods' kettle bank directs waste to a catch tray beneath the kettle which is very difficult to access for cleaning and typically results in waste spreading out over the floor.

Simple pipework will be installed to redirect the waste to a more accessible location saving 28 kL annually in reduced water and cleaning time. The hose used for cleaning beneath the kettles no longer requires such high pressure enabling a reduction in the hose diameter, saving an additional 47 kL annually. The total savings in water and tradewaste charges is approximately $250 a year. (Prepared Foods is an ecoBiz participant.)

Waterless conveyor lubrication

Water used to lubricate conveyor belts often contains impurities such as oil and grease that make recycling difficult.

Waterless systems that rely on a non-stick lubricant, while more expensive, can save water and also reduce wastewater generation and microbiological problems.

CHANGING TO WATERLESS CONVEYORS SAVES MONEY

Coca Cola Amatil used approximately 2.5 per cent of its total water consumption to lubricate its conveyors. Using synthetic lubricant across all five sites saved approximately 71 ML of water annually. While expensive, water savings were reported at 3-5 mL per 1,000 bottles.

Waterless vacuum pumps

Traditional liquid ring vacuum pumps use water to create an effective seal. Where there is a risk the vacuum pump water may come into contact with product, then potable water must be used to prevent contamination. However, if the water does not come into contact with product, significant water savings can be made using a closed loop recirculating system.

Whilst a waterless vacuum pump may have higher initial capital costs than the traditional liquid ring vacuum pump, savings in water, wastewater and energy can lead to payback periods of less than two years depending on the circumstances.

For more information visit: Sydney Water, 2004, The Liquid Ring Vacuum Pump, www.sydneywater.com.au/Publications /FactSheets/LiquidVaccumPump.pdf

Radio and microwave thawing or tempering

Thawing or tempering (partial thawing) products in tubs of water with a continuous stream uses large amounts of water. Systems such as sprays, ambient air or air blasting require little or no water. Similarly, thawing in refrigerators reduces water use but can be time, energy and space consuming.

The use of micro and radio waves for thawing and tempering is an emerging technology. Radio waves are longer in length than microwave and penetrate into the centre of the product to distribute the heat energy in a more even and controlled manner.

Products can be thawed while still in packaging, reducing product handling and contamination risks. Since thawing times can be minutes, rather than days, inventory control can be improved allowing 'just-in-time' management.

Radio frequency has been used to defrost meat, seafood, poultry, fruit, butter and cheese, making it adaptable to most products.

RADIO FREQUENCY TEMPERS BACON

Keam Holdem Australia tempered a 15kg carton of middle bacon using a continuous radio frequency tunnel. It took just over two hours to raise the temperature of the bacon from -18 °C to -2 °C, at which stage the bacon was ready for further processing and still in its original packaging.

This series of fact sheets provides examples and suggestions to the modern food processor on how to achieve both economic and environmental benefits from eco-efficiency. Visit the project website www.ecoefficiency.com.au for more ideas and case studies.

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This series of eco-efficiency fact sheets will demonstrate the importance of water in a modern food factory and suggest areas where savings can be made. The project website www.eco-efficiency.com.au has more ideas and case studies on water savings across the food industry.

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