Water use in the dairy processing industry

Grant Crothers, CEO, Burra Foods

The Australian dairy industry is one of the country's most important food and export industries, valued at $3.2 billion at the farmgate in 2004/05. [1]

Global demand has seen record rises in the value of processed dairy foods – increases of more than 50% have been seen in some commodities in the past six months. Prior to this, dairy processing was the largest value-added food industry, increasing values more than three-fold through processing, to contribute $9 billion to the nation's economy. That leveraging ratio is now certainly due to be much higher.

The dairy processing industry employs about 16,000 people at more than 70 manufacturing sites producing milk, cheese, yogurt, ice-cream, butter, powders, and dairy and pharmaceutical ingredients.

Milk production in Australia is mostly concentrated in the south-east of the country, with the States of Victoria, Tasmania and South Australia accounting for 78% of the total output in 2005.[2]

[1] Australian Dairy Manufacturing Industry State of the Environment Report, a Dairy Australia report on behalf of the Dairy Manufacturers Sustainability Council, June 2007

[2] Australian Dairy Manufacturing Industry State of the Environment Report, a Dairy Australia report on behalf of the Dairy Manufacturers Sustainability Council, June 2007

In Australia, food processors consume more water than any other manufacturing group. They account for 34% of the total water consumption of the manufacturing sector, totalling 180GL/year (AATSE 1999).

Nevertheless, the industry is aware of the need to use less water. A 2001 survey by the Australian Food and Grocery Council found that around 48% of companies reported reductions in water consumption over the preceding five years, more than half of which were by more than 10%. The survey also showed that 67% of companies expected further reductions in the next five years. This suggested a high level of awareness of water consumption issues among food processors.

DAIRY WATER USE

Victoria, the most dairy-centric state, saw the influence of the industry on its water usage in 2004/05, according to the ABS Water Account.

The state's manufacturing industry was a significant user of water, consuming 2% of total water consumption, with the food, beverage and tobacco industry, at 37 GL, the largest users of water within manufacturing.

As an aside, it should be noted in that period the largest water use within the agriculture industry was for dairy farming which used 1,710 GL or 52% of total agricultural water use, and that agriculture overall accounted for 66% of total Victorian water consumption.[3]

A similar situation occurs in Tasmania.

---

3 http://www.abs.gov.au/AUSSTATS/abs@.nsf/mediareleasesbyReleaseDate/CF764A3639384FDCCA257233007975B7?OpenDocument#Water%20Account%20Australia%202004-05_0

WHERE IS WATER USED?

Water is used by food manufacturers for processing; cleaning equipment; for utilities such as boilers, cooling towers and pumps; and for ancillary uses such as toilets and washing facilities. Here is an example of water use for four food processors:

TABLE 1

Water use	**Beverage %**	**Meat %**	**Vegetable %**	**Dairy %**
Plant cleaning	25	48	15	49
Cooling towers	2	2	5	6
Process operations	8	47	78	42
Auxiliary use	5	3	2	3

Source: UNEP Working Group for Cleaner Production 2002a, 2003l

Some dairy plants are located in communities without abundant potable water sources and can have a major draw on the local fresh water resources.

AN INTERNATIONAL PERSPECTIVE

Dairy processors track the ratio of water to raw milk intake to measure productivity.

Europe

In Europe, water consumption has been reported as ranging from 0.2 to 11 L/L milk, with effluent volumes per raw milk intake in the same range.[4]

United States

Milk product losses typically range from 0.5 percent in large, technologically advanced plants to greater than 2.5 percent in small, old plants. “Water usage in most plants could be decreased to approximately 0.50 L/kg milk equivalent processed.”[5]

[4] http://www.gpa.uq.edu.au/CleanProd/dairy_project/Fact%20Sheet%209%20(4).pdf

[5] Water efficiency manual for commercial, industrial and institutional facilities. http://www.p2pays.org/ref/01/00692.pdf

TABLE 2

Summary of American Dairy and Milk Processing Plant Effluent Loadings

	Kg wastewater/kg milk (average)
Milk	3.25
Cheese	3.14
Ice cream	2.80
Condensed milk	2.10
Butter	0.80
Powder	3.70
Cottage cheese	6.00
Cottage cheese and milk	1.84
Cottage cheese, ice cream, and milk	2.52
Mixed products	2.34

“In recent years, technological innovations with membrane systems have provided many new opportunities…The outflow from

reverse osmosis treatment can be of better quality than the native water."[6]

Australia

Ratios for Australian processors producing any combination of white milk, cheese, powders or yoghurts range from 0.07 L/L milk to 2.90 L/L milk, with the average being around 1.5 L/L milk.

TABLE 3

Water to milk ratios

	Average
Milk & dairy desserts	1.6
Cheese and whey	1.9
Powdered products	1.5

Source: Australian Dairy Manufacturing Industry State of the Environment Report, a Dairy Australia report on behalf of the Dairy Manufacturers Sustainability Council, June 2007

[6] Water efficiency manual for commercial, industrial and institutional facilities. http://www.p2pays.org/ref/01/00692.pdf

REBIRTHING WATER

Dairy factory wastewater with a high organic strength can place a significant burden on small-scale wastewater treatment plants within municipal sewerage systems

Milk is approximately 87% water and this can be almost fully recovered to potentially provide up to 100% of total water requirements. Water use during processing could be as low as 0.1 litres/litre by using water recovered during the drying process.

Milk powder production provides great potential to reclaim water from the drying process.

Despite a huge negative community perception to recycled water, it offers a huge opportunity.

Technology exists to return it to the water cycle as potable water, or at the very least for irrigation.

We have a 40-50km outfall pipeline going to the sea through farmland. Because of Victorian Government policy on recycled water, we can’t offer that for irrigation.

On top of that, 200m from our factory we have a pumping station to the town water supply reservoir.

So we have existing infrastructure to recycle high-grade water at minimal cost.

And yet 50km away, the Victorian Government is planning to spend $3.1bn on a desalination plant to create the same product as we seek ie fresh, potable water.

If you were to take all of Gippsland's milk, about 2bn litres and assume 60% goes through a dryer to become milk powder, it means the practical recoverable water is more than 1.2bn litres.

At Burra Foods we almost halved water use over the first three months of last year.

We had already cut water by 30% in the 18 months to the preceding Spring.

Our water savings are better-than-average because we make specialised food components rather than bulk commodities.

Our processing system tends to be more water-intensive than traditional milk spray dryers.

Being niche-focussed, we don't have the economy of scale.

We produce a wider range of products than most sites, meaning we're swapping processes more often, which can be water-hungry, too.

These operations means the water-saving fundamentals are against us. And yet, despite all this, we will become water-neutral over the next year.

Furthermore, we could supplement the water of the Korumburra Township with accredited food-grade recycled water. That's 120,000 litres a day that we could put back into the system. However, the State Government authorities say no.

CONDENSATE RECOVERY

Condensate recovery systems are widely used in Australian dairy factories and can provide a substantial percentage of total water supplies.

Vapour condensate, also known as 'cow water', is used in numerous areas of the plant such as boiler and cooling tower feed water, CIP systems, reconstitution of powdered products, cheese curd wash water, dryer wet scrubbers, indirect heating (via heat exchange) and pump seal water.

Condensate is also a good source of heat energy and can be used to cut heating costs for pre-heating product or boiler feed water.

CASE STUDY: Recovery of condensate water

Murray Goulburn in Koroit installed a condensate water recovery tank and automated its water recovery system. The move boosted the site's water holding capacity by 1 million litres and saves $50,000 annually. For a capital outlay of $200,000 the plant now obtains more than 90% of total water requirements from recovered condensate.

WASTERWATER REUSE

Wastewater reuse can range from processing and wastewater treatment - usually in urban areas - to irrigation of crops and pasture – in rural regions.

The feasibility of using wastewater for irrigation can depend on the total concentration of dissolved salts and the concentrations of specific salts, along with soil and crop type, prevailing topography and climate and the irrigation method.

CASE STUDY: Wastewater reuse

Bonlac Foods in Stanhope has underway a plan to reuse 100% of its wastewater as irrigation. Previously the water was irrigated to land over summer and to surface waters during winter. The project will involve building new storage and treatment lagoons and the preparation of in excess of 250 hectares of land for irrigation.

WHAT ABOUT WATER QUALITY?

The potential for water reuse will largely determine the quality required and the level of treatment necessary, as well as the previous in-factory use.

Some wastewater is relatively clean and can be recycled or reused almost immediately.

All water in contact with product must be of drinking water quality and meet the Australian Drinking Water Guidelines.

Recovered water from evaporator and boiler condensate can be used in numerous areas of the plant including boiler and cooling tower feed water, CIP systems, dryer wet scrubbers, indirect cooling in heat exchangers and pump sealing water.

Segregating wastewater steams also enables plants to maximise the ability to reuse wastewater and helps reduce product loss.

CASE STUDY: Fractionalising waste

UK cheese processor, Joseph Healer Ltd was losing around 90% of the milk the company used for cheese-making in its wastewater (whey), which was either disposed of or spread on farmland. The company installed a three-stage ultrafiltration, nanofiltration and reverse osmosis membrane wastewater treatment system to recover whey protein and lactose; and the water was reused for cleaning membrane units and as boiler feedwater. As at 2003, the new treatment system was saving the company A$1,643,684/year and payback period was 1.5 years.

----------END----------