



Green Cleaning:

new sustainable systems for cleaning farm milking equipment

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Trial Farms Summary Report

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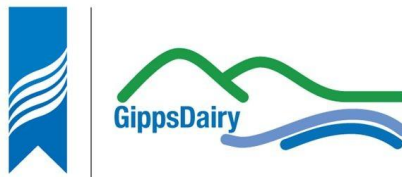
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The Green Cleaning project's Industry Partners were:



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Performance of Green Cleaning™ systems

‘Proof of concept’ trial site

The ‘proof of concept’ trial demonstrated that a low temperature re-use system can be used successfully to clean milking machines. The Green Cleaning trial unit was shown to be environmentally sustainable, economical to operate and could maintain the highest standards in quality milk. The key findings from the trial were a:

- >75 % reduction in electricity used for heating water for cleaning milking machines;
- >65% reduction in electricity costs associated with heating water for cleaning milking machines;
- 63% reduction in water used in cleaning milking machines; and
- 10-30% reduction in chemical use.

The Green Cleaning trial unit was able to maintain good plant hygiene. Milk quality was not compromised and remained within the dairy factory’s premium quality category.

A detailed report about the trial was released in June 2010 (Hakim, 2010).



Figure 1: The Green Cleaning unit at the trial site in Yarragon, West Gippsland

Industry Partner commercial trial sites

Four commercial trial sites were established in early 2011, covering the three main dairying regions in Victoria - one site in Gippsland, one in Northern Victoria and two sites in Western Victoria. Field days have been held at each of these sites. Historical electricity consumption and milk quality data was collected for each site, with monitoring continuing as the Green Cleaning™ systems were commissioned.

At the time of this report (June, 2011) the new systems are still being 'fine tuned' to extract the best performance in terms of cleaning efficacy and energy use. As such detailed performance figures for each site are not available. However, anecdotal information from each of the sites is that cleaning performance has been better or at least consistent with the pre-trial situation.

Measurement of electricity consumption was performed indirectly by either monitoring heating element operating times, or by calculations from temperature profiling of the volumes of water/cleaning solutions being heated. These measurements were then related to meter readings reported by the electricity retailer.

Establishing a baseline of consumption for each farm using the electricity consumption reported by the retailers for comparison with the new systems was challenging. On all sites the electricity consumption data (from the bill) varied considerably over the year. Each site also used a different cleaning regime before installation, so the electricity used to heat water for milking machine cleaning was not well correlated to dairy size. Some sites used the conventional 'hot wash' cleaning regime whilst others used a variety of 'cold' rinse or 'cold' acid cycles. One site also changed cleaning regimes over the year as well as the method of heating water (installation of a solar collector). One of the sites in the Western Districts had an existing re-use system based on hot alkali. Historical electricity consumption data for each of the commercial farm trial sites is given at Appendix 2.

To provide some consistency we have reported the electricity savings for each site in terms of the savings generated by the Green Cleaning™ system in comparison with the standard 'hot wash' regime that typically would be used in a dairy of the same size. This was calculated by entering the operating parameters for each site into the 'Economics Calculator' (http://www.agvetprojects.com.au/greencleaning/Calculator_Eco.html).

Validation of this methodology was undertaken by AgVet Projects at the original Yarragon trial site comparing electricity used by the heating elements (calculated from logged element 'on' time) with the calculated energy use from the model. The calculated use was within 5% of the actual use.

Analyses of the historical milk quality data has revealed that milk quality has been variable on all four farms. Nearly all farms on occasion had either high bactoscan/TPC and/or thermoduric results in the 12 months preceding installation of their Green Cleaning™ systems. Factors such as ineffective cleaning regimes, inadequate maintenance of some components (e.g. blocked jettors, perished milk contact rubberware) and inconsistent routines have been identified as possible reasons for the inconsistent results. This highlights the fact that many factors can influence milk quality results, not just the cleaning system or the detergents used. In addition to the factors already mentioned, milk cooling performance, cleanliness of the teats and milking routine hygiene all contribute to the bacterial numbers in milk.

Jindivick – GEA Farm Technologies & Cleantec

The system installed at Jindivick was designed and built by GEA Farm Technologies and used chemicals supplied by Cleantec – a division of EcoLab. This system was commissioned in January 2011. Heat for the cleaning solutions is supplied by a heat recovery unit that utilises waste heat from the refrigeration unit. The existing hot water services are used to supply any additional heat required via a closed loop circulating hot water through a heat exchange coil mounted in each of the tanks.



Figure 2: Jindivick trial site

The cleaning program used is similar to that used at the Yarragon trial site (post-milking rinse, alkali wash, intermediate rinse, acid sanitizer cycle). The alkali is heated to 55°C (the aim is to heat to 50°C) and the acid sanitizer is heated to 40°C. Chemical dosing is automated and calculated from electrical conductivity readings taken in the solution return pipe.

The control system has some ability to log data, which was used to refine the system. Early figures logged by the system have revealed substantial savings in electricity, water use and hence operating costs (see Table 1). Chemical savings are yet to be quantified. Monitoring is continuing.

Table 1: Comparative performance at the Jindivick trial site[#]

Parameter	Conventional cleaning	Green Cleaning™	% Savings
Electricity use (kWh/day)	122.7	25.6	79%
Water use (L/day)	2100	760	64%
Chemical use (L/day)	N/A	N/A	10%
Energy costs (\$/day)	12.52	2.61	79%
Operating costs (\$/day)*	26.7	14	47%
Greenhouse gas emissions (tCO ₂ -e/year)	59.3	12.4	79%

[#] Based on actual operating parameters modelled though the 'economics calculator' tool

* Costs based on first year only for electricity, water and chemicals

Wangoom – Cleantec

The system and chemicals at Wangoom were developed by Cleantec – a division of EcoLab. This site was commissioned in mid-March 2011. This system makes use of a newly registered alkali sanitizer that enables a two-cycle cleaning program to be used: a post-milking rinse and the detergent/sanitizing cycle. The alkali sanitizer is heated to 50°C (using an electric element directly mounted in the tank) while the acid sanitizer is used at ambient temperature. Chemical dosing is automated and calculated from electrical conductivity readings taken in the solution return pipe.



Figure 3: Wangoom trial site

This system also logs information about each wash cycle and can be used to provide operational information (see Table 2). Several changes to the operating parameters have been made by the farmer since installation so it may take several more months to reach a steady state. Monitoring is continuing.

Table 2: Comparative performance at the Wangoom trial site[#]

Parameter	Conventional cleaning	Green Cleaning™	% Savings
Electricity use (kWh/day)	131.9	37.2	72%
Water use (L/day)	2100	1215	42%
Chemical use (L/day)	N/A	N/A	40%
Energy costs (\$/day)	11.34	7.97	29.7%
Operating costs (\$/day)*	24.22	11	54.6%
Greenhouse gas emissions (tCO ₂ -e/yr)	65.94	18.6	72%

[#] Based on actual operating parameters modelled though the 'economics calculator' tool

* Costs based on first year only for electricity, water and chemicals

Grassmere: Milka-Ware & Tasman Chemicals

The system at Grassmere was designed and built by Milka-Ware. This re-use system has been in operation since 2008 but was adapted in May 2011 to meet Green Cleaning™ specifications. The pipework was also insulated to help minimise heat losses during the wash cycles. Chemicals for this system, supplied by Tasman Chemicals, are dosed automatically and their concentrations monitored via electrical conductivity readings taken by probes in each of the chemical tanks.



Figure 4: Grassmere trial site

Although the original re-use system used less power, water and chemicals than a conventional cleaning system, further savings were still achieved after adopting the Green Cleaning™ principles. The main savings from the original re-use system were generated by changing the chemicals used; particularly the alkali. The new alkali enabled the temperature the alkali wash cycle to be reduced from 85°C to 50°C. Insulation of the milk & wash solution contact pipes has reduced heat losses thereby saving more electricity. Manual recording of operating parameters has provided some early data on the savings achieved (see Table 3). Monitoring is continuing.

Table 3: Comparative performance at the Grassmere trial site[#]

Parameter	Conventional cleaning	Green Cleaning™	% Savings
Electricity use (kWh/day)	146.5	34.8	76%
Water use (L/day)	2400	1495	38%
Chemical use (L/day)	N/A	N/A	10%
Energy costs (\$/day)	10.74	2.56	76.2%
Operating costs (\$/day)*	24	9.63	60%
Greenhouse gas emissions (tCO ₂ -e/year)	73.3	17.6	76%

[#] Based on actual operating parameters modelled though the 'economics calculator' tool

* Costs based on first year only for electricity, water and chemicals

Horfield: GEA Farm Technologies & Tasman Chemicals

The system at Horfield is the second system designed and built by GEA Farm Technologies and uses chemicals supplied by Tasman Chemicals. This system was commissioned in mid-May 2011.



Figure 5 - Horfield trial site

This site is similar to the installation at Jindivick in nearly all respects except for the temperature of the acid sanitizer which is used at ambient temperature on this farm.

Early data from this site are indeed promising with very large reductions in electricity use and greenhouse gas emissions. Savings in chemicals are yet to be confirmed but indications suggest a saving of about 40%. Analysis of the early data is presented in Table 4. Monitoring is continuing.

Table 4: Comparative performance at the Horfield trial site[#]

Parameter	Conventional cleaning	Green Cleaning™	% Savings
Electricity use (kWh/day)	100.46	6.09	94%
Water use (L/day)	2400	1537	36%
Chemical use (L/day)	N/A	N/A	40%
Energy costs (\$/day)	15.01	0.91	94%
Operating costs (\$/day)*	28.31	9	68.1%
Greenhouse gas emissions (tCO ₂ -e/year)	50.2	2.2	94%

[#] Based on actual operating parameters modelled through the 'economics calculator' tool

* Costs based on first year only for electricity, water and chemicals

Dairy hygiene summary

Inspections of the plants at the various sites were undertaken periodically to monitor the efficacy of the new systems. Regular monitoring helped to identify causes and risks to changes in milk quality. For example, two separate inspections at two different trial sites identified variable levels of cleanliness in cluster assemblies, suggesting uneven flow rates between jettors. Further investigations found some jettors were partially blocked, causing restrictions to the flow of cleaning solutions through some clusters.

It will take several months of consistent operation before the various sites are expected to reach a “steady state”, and give the industry confidence that consistently good dairy hygiene is achievable. Based on the ‘proof of concept’ trial we know this is possible, but no firm conclusions can be made about the efficacy of Green Cleaning™ systems until the Industry Partners have finished refining their chemicals and operating parameters.



Figure 6: Milking machine components were inspected for cleanliness periodically.

Greenhouse gas emissions summary

The reduction in greenhouse gas emissions is directly proportional to the electricity savings attributed to using the Green Cleaning™ system. Total annual savings of electricity estimated for each of the trial sites ranged from 34 MWh to 40.8 MWh. Based on Victorian electricity emissions factors (Department of Climate Change and Energy Efficiency, 2010), this is equivalent to reducing greenhouse gas emissions on each farm from between 46.5 tCO₂-e/yr and 55.9 tCO₂-e/yr.

“I think it (demand for Green Cleaning™ systems) all depends on what happens politically with the price of carbon and the potential for electricity prices to increase. If prices rise, then I think there will be more interest in it. It also depends on the economic climate for dairying. If dairying has a really good year, then there is more scope for infrastructure improvement or expansion, so there might be more interest then.”

Dairy adviser respondent (Watson, 2011)

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Appendices

Appendix 1 – Green Cleaning™ product information

SUPPLIERS OF GREEN CLEANING SYSTEMS			
Company	Contact Information	Equipment	Chemicals
 Cleantec – A division of EcoLab	Nick Ruwoldt 0417 071 664	YES	YES
  Daviesway/DASCO	www.daviesway.com.au DOWNLOAD BROCHURE	YES	YES
 DeLaval	Rowena Harper	NO	PENDING
 GEA Farm Technologies (formerly Westfalia Surge)	Email GEA DOWNLOAD BROCHURE	YES	NO
  Milka-Ware/Dairymaster	Werner Schmidt 0417 339 565 03-9768 2424	YES	NO
  Tasman Chemicals	Keith Sadlier 03-9587 6777	NO	YES

Appendix 2 – Historical electricity consumption of the commercial trial farms

Parameter	Farm 1	Farm 2	Farm 3	Farm 4
Twelve month period	May 2010 - April 2011	March 2010 - March 2011	February 2010 – February 2011	May 2010 – May 2011
Twelve month electricity consumption (kWh)	127,770	131,781	113,760	152,255
Peak electricity consumption (kWh)	43,960	44,412	52,400	52,723
Off peak electricity consumption (kWh)	83,810	87,369	61,360	99,532
Average daily electricity consumption (kWh/day)	350	361	312	417
Average daily peak electricity consumption (kWh/day)	120	122	144	144**
Average daily off-peak electricity consumption (kWh/day)	230	239	168	273**
Total costs *	\$18,680	\$17,465	\$15,419	\$23,180
Total peak	\$10,702	\$8,452	\$10,914	
Total off peak	\$7,977	\$9,013	\$4,505	

* Costs exclude supply charge and GST

** This represents kWh used during peak and off peak times, but this farm is on a 'spot price' contract so isn't charged specific peak and off peak rates