Final report

Best practice in meat processing – The Econoliser and water use efficiency

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Abstract

Improving energy and water efficiency is an ongoing goal in meat processing facilities to reduce costs and meet consumer-driven demands for improved environmental, social, and corporate governance best practice. The aim of the current project was to assess if Econoliser sterilisers could improve the efficiency of the sterilisation process in an Australian meat processing facility. Econolisers (48 units) were incorporated into the Signature Beef Facility in Clermont, Qld This facility was built off-grid and relies on diesel generators for power and underground bores for water. Thus, reducing the use of energy and water at this plant was vital to reduce costs and conserve scarce environmental water reserves. Initial trials found water usage reductions from use of Econolisers exceeded expectations. Use of the Econoliser system also reduced energy consumption and steam levels because less water had to be heated for sterilisation. Finally, the Econoliser reduced protein build up on equipment pieces which is an inherent problem when pieces are left in a conventional sterilise for lengthy periods of time. Overall, the Econoliser is well suited to Australian meat processing facilities and is a technology which can assist meat processors to meet their carbon goals, maximise production and reduce inputs.

Executive summary

Background

The project was undertaken on behalf of the Angus family's Signature on Farm greenfield beef processing facility (referred to as Signature Beef). This facility is the first beef abattoir built in Queensland in the last thirty years. The facility was built off-grid and relies on diesel generators for power supply. Hot water is solely generated from hot water jackets encompassing the generator radiators removing the need for the plant to have a coal or gas fired boiler. The facility is also not connected to town water and must rely on underground bore water. Consequently, water and energy use need to be limited due to scarcity of resources (for water) and high costs (diesel) and were identified as key factors to minimise input costs and maximise production levels.

An input analysis identified conventional dip sterilisers as a technological tool that contributed to the inefficient use of energy and water in meat processing plants. The aim of the current project was to assess if Econoliser sterilisers could be incorporated into an Australian meat processing plant to improve the efficiency of the sterilisation process.

Objectives

1. Ensure the Econoliser meets current Australian industry standards
2. Ensure the Econoliser operates satisfactorily as a knife and equipment sterilisation unit and maintains carcass hygiene
3. Reduce daily water (by 25% to 50%) and energy use
4. Enhance the sustainability profile of the Australian meat processing industry (with a particular focus on European markets)

Methodology

- the initial planning phase: The import and testing of one Econoliser unit in unrestrained conditions
- design of bespoke Econolisers equipment pieces that had not previously been incorporated in other plants
- implementation of the system in the plant: Fitting of 48 Econolisers units into various stations within the plant, including the installation of monitoring equipment (the SCADA system) to measure the performance of the sterilisers and other water points throughout the plant
- use and analysis of the system: Training employees to use the Econoliser system and conducting quality assurance analysis for biological materials and correct operation of the equipment (e.g. water and energy requirement in situ)
- extension activities: Development of a cost–benefit analysis for the use of Econoliser technology in Australian processing plants

Key findings

1. The initial trials of the Econolisers during commissioning of Signature Beef were of factory standard.
2. The QA results from microbial swabs of the Econoliser equipment passed industry standards.
3. Reductions in water usage from the use of Econolisers exceeded expectations to this point and energy reductions met manufactures specifications. However, the facility is still in the commissioning phase and further analysis when it is fully functional is recommended.
4. As the Econoliser uses less hot water in the sterilisation process it also creates less steam. This reduces refrigeration costs required to combat a humid slaughter floor and reduces carcass temperature.
5. Use of the Econoliser reduces protein build up on equipment pieces which is an inherent problem when pieces are left in a conventional sterilise for lengthy periods of time.

Benefit to the industry

Overall, the Econoliser is well suited to Australian meat processing facilities and is a technology which can assist meat processors to meet their carbon goals, maximise production and reduce inputs. A cost–benefit analysis is included in the Appendix (8.2) to demonstrate the potential operational savings (from reduced energy and water requirements) of using Econoliser sterilisers. Key benefits to industry include:

- major water saving opportunities for all processing facilities
- reduced cost to make potable water
- reduced cost to treat wastewater
- reduce energy costs to make hot water
- improved refrigeration performance through the removal of steam from process areas
- the potential for improved microbiological performance with the removal of warmth, moisture and potential for condensation on the slaughter floor
- improved control of sterilisation process as each individual sterilisation can be monitored through the SCADA system.

Future research and recommendations

Care should be taken to ensure equipment routinely used in Australia can be used in the Econoliser units.

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1. Background

Water usage in meat processing plants is a significant cost and a limiting factor in the Australian meat processing industry. Water costs to a meat processing plant are threefold as there are costs associated with sourcing water, treating water and disposing of liquid waste. Another unquantified and little queried cost of water use in processing is the refrigeration load that excess moisture creates. In regional areas access to water may also impact profit by reducing production limits because of water scarcity at greenfield sites.

The project was undertaken on behalf of the Angus family who are developing a meat processing plant in Clermont, Northern Qld. The facility, Signature on Farm greenfield beef processing facility (referred to as Signature Beef) is the first beef abattoir built in Queensland in the last thirty years. The facility was built off-grid and relies on diesel generators for power supply. Hot water is solely generated from hot water jackets encompassing the generator radiators removing the need for the plant to have a coal or gas fired boiler. The facility is also not connected to town water and must rely on underground bore water. Consequently, water and energy were both limited resources due to scarcity of resources (for water) and high costs (diesel). Minimising energy and water usage were identified as key factors to minimise input costs and maximise production levels.

A detailed review of current standard practices in water usage within industry was undertaken and the decision was made to set daily water usage targets with revised targets set well below industry standards by implementing alternate, innovative processes. Although it should be noted that when using industry standards for water usage it needs to be tabled that Signature on Farm has no rendering on site which is a high user of water.

Reported water usage between abattoirs varies substantially, ranging from 3.8 to 17.9 kL per tonne of carcase weight produced (MLA, 2008). Due to the scarcity of water at the Signature Beef plant a target below the minimum range, of 315 000 litres per day, was set for Signature Beef. The equipment sterilisation process was identified as a major water user. Sterilisers have been reported to use 0.5 (for small insulated knives) to 11.5 (for brisket cutters) litres of water per minute per steriliser (MLA, 2011), with an average usage of 7 L/min. Waste water caused from continuous running of sterilisers regardless of use is a common area of water wastage in the industry. The process also wastes energy because of the considerable energy costs required to raise the temperature of the potable water to 82°C. In addition, the constant operation of these sterilisers increases ambient heat and humidity in production areas that must be counter-acted with air conditioners to maintain room temperatures that meet regulatory standards. Finally, equipment that is also left in sterilisers for extended periods of time on slaughter floors tend to have a build up of protein on the equipment which increases cleaning time to remove caused from the scum that forms on conventional sterilisers.

An input analysis identified conventional dip sterilisers as a technological tool that contributed to the inefficient use of energy and water in meat processing plants. The aim of the current project was to assess if Econoliser sterilisers could be incorporated into an Australian meat processing plant to improve the efficiency of the sterilisation process.

The aim of this project was to assess if the use of sensor-enabled spray knife Econoliser sterilisers could reduce water and electricity costs associated with knife sterilisation in meat processing plants. The Econoliser is produced in Northern Ireland and has used in many European meat processing facilities but has never been trialled in Australia. Thus, a key initial step of the project will be the acceptance of the sterilisers by state and national food safety bodies. Following this they will be implemented in the Signature Beef plant to evaluate their effect on energy and water use. Given the unique and individual design of each and every steriliser to the specific tool of use, a number of not previously developed sterilisers were designed and manufactured. The system was monitored for quality assurances purposes to ensure their proper use and that effective sterilisation is taking place. The project not only assesses the technology but also the way in which the technology engages with the operation and the people within an Australian plant.

As the facility is a greenfield site an opportunity exists to redefine water use efficiency from lairage to loadout. The development of a whole of plant approach to water efficiency will provide a best practice model for water usage in the meat processing industry that reduces input costs and maximises production levels. The results of the research will be used to inform the industry on practical methods that can implement to reduce their input costs, maximise production and reach their Carbon Neutral targets and timelines.

2. Objectives

1. Ensure the Econoliser meets current Australian industry standards
2. Ensure the Econoliser operates satisfactorily as a knife and equipment sterilisation unit and maintains carcass hygiene
3. Reduce daily water (by 25% to 50%) and energy use
4. Enhance the sustainability profile of the Australian meat processing industry (with a particular focus on European markets)

Broadly these objectives were met. However, delays in the commissioning of the plant meant that accurate representation of the energy and water usage of a fully functioning plant using Econoliser knives were unable to be recorded. Initial data only is provided.

3. Methodology

The initial planning phase

A unit was imported and tested in unrestrained conditions. The initial unit was tested to ensure performance before the installation of the 48 units at each of the stations in the later phase of the project (see appendix 8.3). The Department of Agriculture, Water and the Environment (DAWE) and Safe Food Queensland were formally notified of intentions to use alternate sterilisation techniques.

Design and manufacture of bespoke units

To achieve low water use (120 mL per shot) each individual steriliser was uniquely manufactured to fit the specific tool required. A range of new Econolisers were developed during the project. These included:

- A dual purpose steriliser to hold both a conventional knife and an air operated de-hider. This saved purchasing two different sterilisers and the associated installation costs at a number of locations where both a conventional knife and dehider are used.
- A steriliser for a bung ring expander

- A steriliser for a conventional electric saw (Milwaukee) utilised for condemn break down
- A steriliser for the spinal cord sucker
- A steriliser for head hooks
- A steriliser for a head bar

Implementation of the system in the plant

The equipment was purchased and significant engineering was undertaken to fit the individual units into various stations within the plant. This included the installation of monitoring equipment (the SCADA system) to measure the performance of the sterilisers and other water points throughout the plant. The installation of individual units at stations throughout the plant will provide real-time measurement of site performance and allow the accurate determination of where problems are occurring in a fast and effective manner. The next step will be to link the SCADA system to data capture systems for effective real-time monitoring.

Use and Analysis of the system

- systems to train employees and ensure the Econoliser system was operating correctly were set-up
- the water and energy requirement of the different types of Econoliser systems (knives, splitting saws, air knives, brisket saws, hock cutters) were preliminarily assessed

Extension activities

The development of cost–benefit analysis for the use of Econoliser technology in Australian processing plants.

4. Results

4.1 The initial planning phase

The initial trial was conducted at the G & B Stainless factory after one Econoliser unit had been sent from England to conduct preliminary trials to ensure all projected outcomes could be met. The trial was conducted under plant conditions. The aim of the initial trial was to determine the ability of the equipment to maintain the 82°C required to meet plant standards.

The Econoliser was connected to the existing cold-water supply which enters through a non-return valve into a 500 mL reservoir hosting a heating element. A probe at the base of the reservoir maintained the water temperature at a set point of 90°C. There is an indicator that verified that the water was above 82°C.The conventional boning knives were then placed into the opening of the steriliser and pressed down to trigger the spray.

There is a proximity switch that can be adjusted to regulate the spray time on the knives and the time was set at 4.5 seconds as per manufacturers recommendation. This setting uses 120 mLs per cycle (as stated by the manufacturer). The Dotmar housing that the knives are housed in was then removed and knives were placed back into the steriliser and pressed down to trigger the spray and visual verification was made of both sprays fully sterilising the knives from the tip to above the start of the handle. The steriliser was tested 10 times per visit and there were 3 visits in total. Over these

30 tests there was less than 5 mL variation from the 120 mL per cycle, as stated by the manufacturer.

Initial views from the trial also verified that clean water was sprayed onto each blade, in contrast to conventional sterilisers that build up a green scum on the surface which then cooks onto the blade of the knife. This contributes to good manufacturing practices.

4.2 Implementation of the system in the plant

Initial approval from DAWE to use alternate sterilisation techniques was formally sought and approved (see Appendix 8.1). Then steriliser specifications were finalised, and the equipment was ordered. In total 48 Econoliser units were installed (see Table 1). Lengthy delays in shipping times for equipment forced Signature Beef to air freight a large component of the equipment to the site. The installation costs are shown in the cost–benefit analysis (see Appendix 8.2).

Table 1: The type and number (shown in brackets) of Econoliser units installed at Signature Beef

Knife sterilisers (26)	Dehiders (3)	Milwaukee saw (1)	Head hook (1)
Whizzer Mach III 1000 (2)	Dehiders /knife combo (3)	Head Bar (1)	Jarvis electric saw (1)
Whizzer Mach III 500 (1)	Hock cutters (3)	Brisket saw (1)	Elastorarator (1)
Whizzer Mach III 620 (1)	Spinal cord steriliser (1)	Splitting saw (1)	Pneumatic rodder (1)

Facility drawings (Figure 1, 2) outline the types of sterilisers that will be used in their location within the facility.

Figure 1: Subsection of the slaughter floor design (location of the installed sterilisers is marked with SS in a red circle)

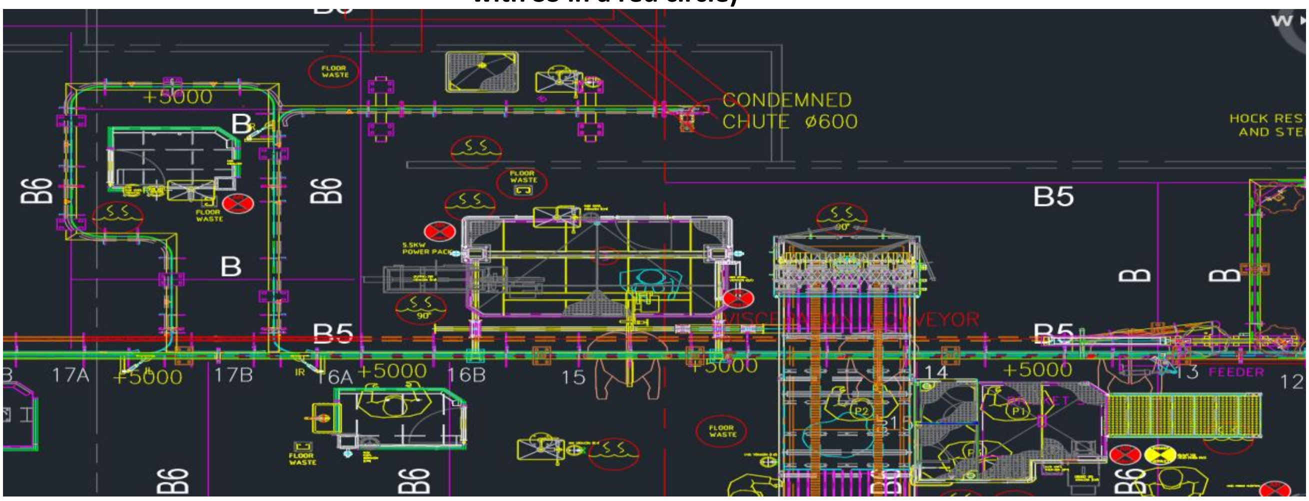
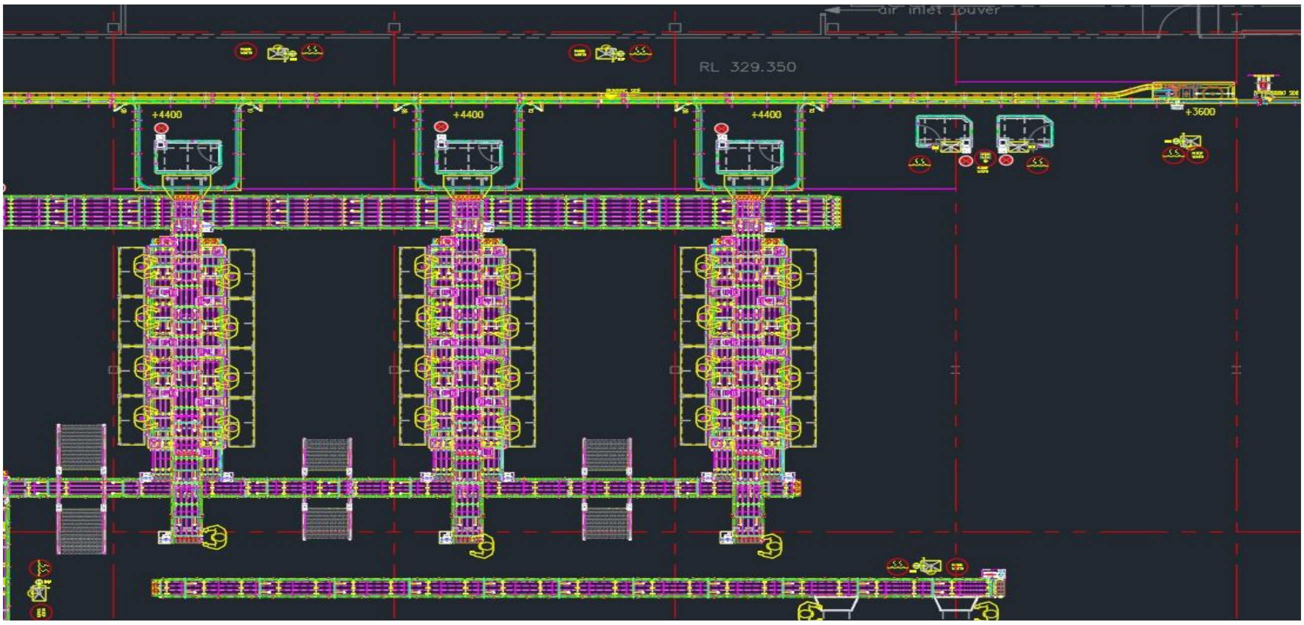


Figure 2: Subsection of the boning room floor design (location of the installed sterilisers is marked with SS in a red circle)



4.3 Implementation of the system in the plant

All handheld equipment specifications and knife specifications were forwarded to the supplier to ensure knives were properly submerged into the sterilisers for effective hot water spray (Figure 3 - 8). It was noted that knives used on plant must be strictly controlled by management as not all knife types will fit in Econoliser sterilisers.

Figure 3: Operation of a splitting saw Econoliser steriliser

Figure 4: Operation of a 1st leg hock cutter steriliser and air knife steriliser

Figure 5: Operation of a splitting saw Econoliser steriliser

Figure 6: Operation of a dual steriliser for air knife and conventional knife on hide puller

Figure 7: Operation of a Brisket Saw Steriliser

Plant employees were trained to use the Econolisers and identify problems with their function. The QA team swabbed randomly selected carcasses and equipment pieces for microbial swabbing to verify effective sterilisation. These initial tests passed QA inspection (see Table 2, 3) and an initial Safe Food Queensland review of the Econoliser sterilisation process was deemed acceptable.

Table 2: Routine (ESAM) carcase swab microbiological results

Carcase swab	Coliforms (cfu/swab)	*E. coli* (cfu/swab)	Standard Plate Count (swab)
1	<10	<10	~60
2	<10	<10	~95
3	<10	<10	<10
4	<10	<10	<10

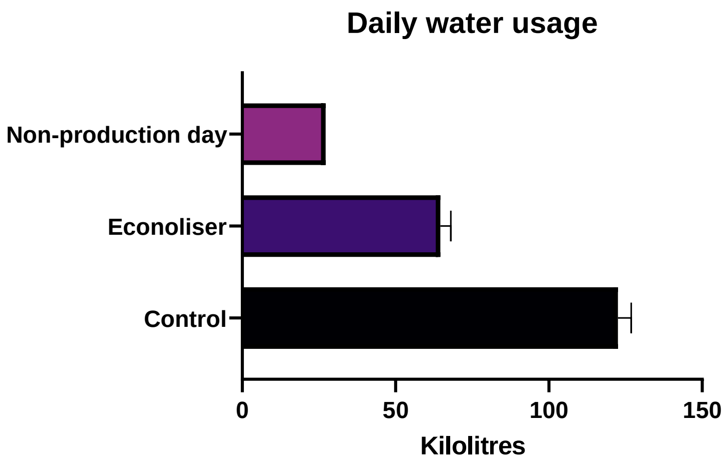
Table 3: Microbiological analysis of swabs from randomly selected Econoliser-treated tools

sample	Coliforms (cfu/swab)	*E. coli* (cfu/swab)	Standard Plate Count (swab)
Knife	<10	<10	<100
Knife	<10	<10	<100
Knife	<10	<10	<100
Knife	<10	<10	<100
Hock cutter	<10	<10	<100
Hock cutter	<10	<10	<100
Brisket saw	<10	<10	<100
Splitting saw	<10	<10	<100
Rodder	<10	<10	<100
Air knife	<10	<10	<100

4.3.1 Assessment of the operational water and energy requirements

Delays in the commissioning of the plant meant that accurate representation of the energy and water usage of a fully functioning plant using Econoliser knives were unable to be recorded. Initial data only is provided. Initial assessment of the water usage of the whole plant shows that installation of the Econoliser system reduced daily water usage by 47% (Figure 9). If you remove water usage that occurs from non-productive activities (light purple in Figure 9) and compare the control with the Econoliser then production-related water usage is reduced by 61%.

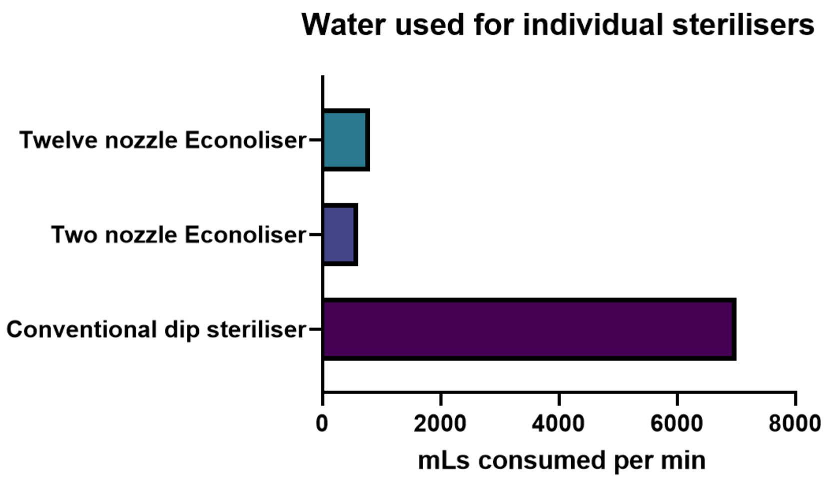
Figure 9: Preliminary data on the water usage of the Signature Beef plant in the commission phase. Early data shows that use of the Econoliser system reduces daily water usage by 47%.



Assessment of the water used by individual sterilisers showed that the water consumption of two and 12 nozzle Econolisers was significantly lower than the water consumption of conventional dip sterilisers (Figure 10). The figure was generated based on the following assumptions:

- standard sterilisers use 7 litres of water per minute
- a 2 nozzle Econolisers has 5 cycles per minute (120 mL per cycle)
- a 12 nozzle Econoliser has 1 cycle per minute (810 mL per cycle)
- based on a production rate of 27 head per hour

Figure 10: Water consumption of conventional dip sterilisers and Econolisers.



Water costs when Signature Beef is operating at full capacity can be predicted (Table 2, 3).

Table 2: Predicted water savings when Signature Beef is operating at full capacity

	Litres	Econoliser units	Total water usage litres
Water Saving of 6 litres per minute - Litres	6	48	288
Water Saving in an 8 hour shift - Litres	2,880	48	138,240
Water Saving in a 235 day year - Litres	676,800	48	32,486,400

Estimates are based on a 6 L reduction in water use on site

Table 3: Predicted operational savings when Signature Beef is operating at full capacity (water)

	Cost per Unit $	Number of Units	Amount $
Water Saving Cost - Kilolitres based on estimates included below	$8.00	32,486	259,891

4.3.2 Assessment of the operational water and energy requirements

The energy consumption targets of successfully running the facility with no boiler has been satisfactory as all hot water is being generated from the hot water jackets from the diesel generators (Table 4).

Table 4: Predicted operational savings when Signature Beef is operating at full capacity (energy)

	Cost per Unit $	**Number of Units**	**Amount $**
Energy Saving - Off-Grid Power – Estimate on power consumption based on off-grid diesel powered	6,417	48	308,000
Water Saving Cost - Kilolitres based on estimates included below	$8.00	32,486	259,891
Total			567,891

4.4 Extension activities

A cost–benefit analysis was developed so information on the benefits of Econoliser sterilisers can be easily distributed to Australian processing plants that are interested in using the technology (see Appendix 8.2).

5. Conclusion

5.1 Key findings

1. The initial trials of the Econolisers during commissioning of Signature Beef were of factory standard.

2. The QA results from microbial swabs of the Econoliser equipment passed DAWE standards (DAWE, 2021).

3. Early data shows that use of the Econoliser system reduces daily water usage by 47%. However, the facility is still in the commissioning phase and further analysis when it is fully functional is recommended.

4. As the Econoliser uses less hot water in the sterilisation process it also creates less steam. This reduces refrigeration costs required to combat a humid slaughter floor and reduces carcass temperature.

5. Use of the Econoliser reduces protein build up on equipment pieces which is an inherent problem when pieces are left in a conventional sterilise for lengthy periods of time, contributing to good manufacturing practices.

5.2 Benefits to industry

Overall, the Econoliser is well suited to Australian meat processing facilities and is a technology which can assist meat processors to meet their carbon goals, maximise production and reduce inputs. A cost–benefit analysis is included in the Appendix (8.2) to demonstrate the potential operational savings (from reduced energy and water requirements) of using Econoliser sterilisers. Key benefits to industry include:

- major water saving opportunities for all processing facilities
- reduced cost to make potable water
- reduced cost to treat wastewater
- reduce energy costs to make hot water
- improved control of sterilisation process as each individual sterilisation can be monitored through the SCADA system

6. Future research and recommendations

Further work has to be undertaken with the equipment supplier to ensure all equipment pieces requiring sterilisation can be effectively sterilised using the Econolisers. As an example, hock cutters used in Australia are normally fitted with the hock grabbers to the place hocks in a chute without physically touching. These hock grabbers are not used in Europe therefore the grabbers had to be removed at Signature on Farm to commence the trial. Knife size and brands must also be agreed to between management and employees and strictly adhered to as not all knives will fit in Econoliser sterilisers.

There will still have to be several conventional sterilisers within the facilities including entry areas to sterilise knife pouches, boning hooks and mesh equipment prior to production and if any of this equipment becomes contaminated during production.

7. References

Department of Agriculture, Water and the Environment; DAWE (2021) Microbiological Manual for Sampling and Testing of Export Meat and Meat Products https://www.awe.gov.au/biosecurity-trade/export/controlled-goods/meat/elmer-3/microbiological-manual

MLA (2008) Review of abattoir water usage reduction, recycling and reuse. Prepared by Malcolm Warnecke, Tony Farrugia, Christobel Ferguson. Project code A.PIA.0086. https://www.mla.com.au/contentassets/ffa6954d3bec4c6c913f789307c8b47c/a.pia.0086_final_report.pdf

MLA (2011) Environmental data analysis. Prepared Dr Ron Brooks. Project code A.ENV.0090 https://www.mla.com.au/contentassets/e90c96b056ba4fc3be5168623529d2a6/a.env.0090_final_report.pdf

8. Appendix

8.1 Approval of Econoliser installation by DAWE

From: Lowden, Stewart <Stewart.Lowden@awe.gov.au>
Sent: Thursday, 25 March 2021 12:00 PM
To: Pat Gleeson <clarifyit@bigpond.com>; Arunagiri, Chinniah <Chinniah.Arunagiri@agriculture.gov.au>; Allan, Samantha <Samantha.Allan@agriculture.gov.au>; Thanabalasingham, Sumana <Sumana.Thanabalasingham@agriculture.gov.au>
Cc: 'Josie Angus' <josie@signaturebeef.com.au>; dale.mesken@gmail.com; 'Ian Jenson' <ijenson@mla.com.au>; Adam.Balcerak@awe.gov.au
Subject: RE: Formal application [SEC=UNOFFICIAL]

Hi Pat

I write to provide department approval of your proposal to install Econolisers on-plant at Signature Beef; ensuring operational compliance with the following:

1) AA to describe the required knife washing procedure before sterilisation
2) AA to describe on how the slaughter operation, especially chain speed is managed to ensure adequate recovery time is provided after three-spray cycle for the water temperature to reach minimum $82^{o}C$
3) AA to describe how continuous monitoring of the steriliser is conducted e.g. data collection using SCADA and how this data is made accessible to QA and department during their daily monitoring and verification, and temperature verification using probe verification points.

Wishing you every success with build and operations.

Kind regards

Stew

Dr Stewart Lowden
National Veterinary Technical Manager | Meat Exports Branch | Exports and Veterinary Services Division

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Australian Government
Department of Agriculture, Water and the Environment

8.2 Cost-benefit analysis of the use of Econoliser sterilisers

Cost-benefit analysis

Econoliser performance was analysed based on a number of parameters identified by the project team and included the increasing cost associated with the Econoliser installation and the operational savings generated from electricity and water use. The outcome of the work was:

- an increase in capital cost $261,382
- a decrease in operational costs of $567,891 per year

The workings for these calculations are included in the report below

Assumptions

- similar labour unit cost for the use of the Econoliser versus the standard steriliser
- enhanced management of quality procedures due to the SCADA System as there is greater control and measurement of steriliser use
- plumbing installation costs will be the same for the steriliser and Econoliser
- increase in electricity costs for Econoliser installation
- a cross rate of AUD to GBP of 0.57
- per litre cost of the business for water of $AUD 8 - including water purchase, post use treatment and disposal at Signature Beef site
- industry calculation of the cost of water of $54 per thousand kilograms of hot standard carcass weight

Cost-benefit calculations

Capital costs

	Cost per Unit $	Number of Units	Total Cost $
Installation of electrics is additional to that required for normal steriliser - estimate supplied by electrical contractors	657	48	31,536
Increase in steriliser capital cost – Based on capital cost of Econoliser less the standard cost of a normal steriliser			229,846
Total			261,382

Operational savings

	Cost per Unit $	Number of Units	Amount $
Energy Saving - Off-Grid Power – Estimate on power consumption based on off-grid diesel powered	6,417	48	308,000
Water Saving Cost - Kilolitres based on estimates included below	$8.00	32,486	259,891
Total per year			567,891

Capital equipment Econoliser

All costs are based on quotes provided by the supplier.

Part Number	Description	Quantity	Rate £	Amount £	Amount AUD
S-TK01-E01-001	Electric Twin Knife steriliser, 2.5kW, 24x38mm blade opening, with External Temperature Display	29	2,650.50	76,864.50	134,850.00
ECSP141	Mounting column/stand for Twin Knife Electric Econoliser	30	229.5	6,885.00	12,078.95
S-DH00-E01-001	Dehider steriliser, 2.5kW, with External Temperature Display	3	2,876.40	8,629.20	15,138.95
S-DH00-E01-001	Dehider and knife steriliser, 2.5kW, with External Temperature Display	3	2,876.40	8,629.20	15,138.95
S-HC10-E01-001	Hock Cutter steriliser, 2.5kW, Top Loader with External Temperature Display	3	3,285.00	9,855.00	17,289.47
S-BK07-E01-005	Econoliser steriliser for Jarvis brisket saw, 2.5kW water heater, electric controls, w/External Temperature Display & HP Wash	1	3,899.70	3,899.70	6,841.58
S-BT05-E01-005	Jarvis Buster 5 steriliser, 5kW, with HP wash & External Temperature Display	1	4,040.10	4,040.10	7,087.89
S-CR02-E01-005	Econoliser Cattle Rodder, Electric, 5Kw, HP WASH, EXT TEMP	1	2,839.00	2,839.00	4,980.70
S-WT11-A01-000	Econoliser steriliser for Bettcher wizzard meat trimmer. Air controls	2	2,689.20	5,378.40	9,435.79
MISC1	New Elastorator Steriliser	1	2,947.00	2,947.00	5,170.18
MISC2	New Milwaukee Saw Steriliser	1	3,222.00	3,222.00	5,652.63
MISC3	New Spinal Cord Sucker steriliser	1	2,947.00	2,947.00	5,170.18
MISC3	New Head Bar Steriliser	1	2,650.50	2,650.50	4,650.00
MISC3	New Jarvis Electric Saw	1	2,947.00	2,947.00	5,170.18
MISC3	Pneumatic Cattle Rodder Tool, Manufactured by EMC	1	1,400.00	1,400.00	2,456.14
MISC3	New Head Hook Steriliser	1	2,650.50	2,650.50	4,650.00
ECSP157	Boiler Cartridge / cassette for twin knife electric Econoliser	2	1,180	2,360.00	4,140.35
ECSP1001	Twin Knife cassette, Electrical, Spares kit	1	705	704.7	1,236.32
Carriage	International Carriage & Duty	1			48,707.94
		80.00		151,043.80	309,864.20

Standard sterilisers

Estimates are based on advice from project consultants with significant knowledge of past costs associated with the installation of sterilisers.

	Quantity	Rate Assumed	Amount AUD
Standard cost for a steriliser	80	1000	80,000

Water Savings – Signature Beef

Estimates are based on a 6 L reduction in water use on site.

	Litres	Econoliser units	Total water usage litres
Water Saving of 6 litres per minute - Litres	6	48	288
Water Saving in an 8 hour shift - Litres	2,880	48	138,240
Water Saving in a 235 day year - Litres	676,800	48	32,486,400

Water and electricity cost – Industry Perspective

These figures will not be used as a part of the calculation, but I used as a benchmark to test the validity of the values generated under the project calculations. The calculations have been derived from AMPC report 2020-1058. The average plant energy use was reported as being 1461 MJ per tonne of hot standard carcass weight.

Total Water Cost	
Head per day	200
HSCW	330
Total HSCW per day	66,000
Days of operation	235
Total HSCW per year	15,510,000
Cost per 1000 Kg HSCW	54
Total Cost of Water for the plant	837,540

8.3 Dr John Sumner's report on Econoliser sterilisers

Validation of an alternative procedure for knife cleaning on the slaughter floor

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1. Introduction

Since the 1960s there have been regulatory requirements in many countries for the use of hot water no cooler than 82°C for disinfection of knives and other implements used during slaughter and dressing operations. The premise for the requirement is that unless knives and other implements are disinfected they may become a source of microbiological contamination. Failure to maintain knife sterilisers at 82°C can lead to suspension of slaughter and dressing.

The Australian Standard (4696:2007) specifies that facilities for cleaning and sanitising implements be provided with an adequate supply of hot potable water at no less than 82°C or receive an equivalent method of sanitising.

In 2003 MLA commissioned Food Science Australia (FSA) to investigate firstly, whether there was any scientific basis for 82°C and secondly, whether alternative cleaning procedures were possible.

After an exhaustive literature review the researchers were unable to find any scientific evidence for the selection of 82°C and concluded, after discussion with colleagues in the USA, that it was a simple conversion of 180°F. The researchers also demonstrated that temperatures cooler than 82°C could be used providing knives were immersed for longer than the momentary dip currently used (Midgley & Eustace, 2003).

A significant amount of research and development over the next years (Eustace *et al*. 2007; Horchner, 2007: Goulter *et al*. 2008) resulted in the acceptance by Meat Standards Committee (MSC) in June 2007, that all jurisdictions would approve future proposals for the use of an alternative procedure for knife cleaning on the following basis:

- Verification of the use of the model by meat processing establishments to demonstrate equivalence, and
- Approval of an arrangement that demonstrates the capacity of the meat processing facility to operate in accordance with the proposal submitted to the controlling authority, and
- Subject to importing country requirements.

To this end, MLA published a guide to assist companies wishing to develop an alternative arrangement based on using water at a lower temperature for a longer time than the current 82°C based system (MLA, 2007). The information included:

- The scientific basis for using alternative knife cleaning systems.
- Technical aspects of putting this into practice.
- An explanation of the model to validate an alternative process.
- The type of information regulatory authorities will need to consider an alternative procedure.

Although alternative arrangements to date have proposed only temperature:time variants as their basis, the same procedure is used in the present trial of an alternative arrangement involving a knife cleaning unit, the Econoliser Two Knife Steriliser.

The unit operates by activating sprays that can remove residues such as fat and protein, and also bacteria associated with them from the knife blade at the same temperature as the current system.

Trials were carried out at the JBS Brooklyn abattoir in Melbourne where operators used both the current and the Econoliser system.

After cleaning, and immediately before use, knives were sponged to remove residues and any bacteria still adhering to the blade.

The results of the trials are presented.

2. Materials and Methods

Study design

A series of experiments was carried out at JBS Brooklyn abattoir, to compare contamination levels on knives after they had been cleaned by rinsing and dipping in 82°C water with those on knives cleaned by rinsing and placing in an Econoliser Twin Knife Steriliser.

Trials were carried out on Wednesday May 1 and Thursday May 2 2019 on a beef slaughter floor operating at 120 head/hour, when yearling cattle in clean condition were being processed.

The assessment was made at two workstations identified as likely to lead to highly contaminated knives: the 1st legging station and the bung ring and drop station. At each station, for each treatment (current and Econoliser) a sample size of 20 knives was used.

Current knife use and cleaning method

In the current method of knife cleaning the operator used two knives with, at any one time, one knife being in use and one resting in a unit filled with 82°C water. The operator is required to use a cleaned knife when incising the hide and when the next carcase is presented at the workstation. After use the knife is rinsed under warm water and placed in the 82°C water bath until required.

Knife use and Econoliser cleaning

The operator's work instructions were as above except that, on completion, the knife was placed in the Econoliser unit until required for the next procedure. Placing the knife in the vacant Econoliser slot activates a spray that envelops both sides of the knife for a specified time; in the present trial spray times of 4 and 6 seconds were used. The knife remained in the Econoliser unit until required by the operator.

Sponge sampling of knives

The blade of the cleaned knife was sampled immediately before its use by the operator (i.e. after it had received its cleaning cycle) by drawing a sterile sponge (Nasco Whirlpak) hydrated in Butterfields solution over both surfaces of the blade from handle to tip.

Transportation of samples to the laboratory

After sampling, sponges in sterile bags were processed onsite for immediate testing.

Determination of Aerobic Plate Count (APC) and *E. coli*

To liberate bacteria the sponge was squeezed firmly through the plastic bag for 30s and, from the moisture expressed, serial dilutions were prepared in 0.1% buffered peptone water blanks (9 mL) using 1mL aliquots. Aliquots (1 mL) from each dilution were spread on either Aerobic Plate Count Petrifilm (3M) or *E. coli* Petrifilm (3M) and incubated at 30°/48 hours and 35°C for 48 hours, respectively. Colonies were identified and counted as colony forming units (CFU) as per the manufacturer's instructions.

Statistical analysis

To enable counts to be expressed in terms of cfu/cm^2 of blade, the area of each knife was calculated by making an outline of the blade on square paper and summing the squares. The area of knives used at legging was 45 cm^2 and at bunging 95 cm^2.

Counts/cm^2 of blade were converted to $\log_{10}$ cfu/cm^2 and the mean of the $\log_{10}$ cfu/cm^2 was calculated. The standard deviation was determined using Welchs' t-test. When no bacteria were recovered from a knife blade the result was recorded as "not detected". The limit of detection for both TVC and *E. coli* was 0.56 cfu/cm^2 for the narrow bladed knives used at legging and 0.26 cfu/cm^2 for the broader, curved blade knives used at bunging.

3. Results

The results are presented in Tables 1 and 2 for total bacterial counts obtained at the legging and bunging stands, respectively where, at both locations, each of the three systems delivered cleaned knives with very low counts, approaching the limit of detection of the test method.

Also, at each of the two locations, the mean count of cleaned knives was lower on those cleaned in the Econoliser unit with a 4 seconds spray (Econo 4) and lower still with a 6 second spray (Econo 6); however, differences between the current and the Econo 4 system were not statistically significant.

There were statistically significant differences between current and Econo 6 at legging (marginal significance) and between current and Econo 6 at bunging (highly significant.

Table 1: Minimum, mean and maximum log and arithmetic counts/cm^2 obtained from cleaned knives at the legging stand using the current and Econoliser systems

	Current [a]	Econoliser 4s [b]	Econoliser 6s [c]
Minimum log (arithmetic)	-0.3 (0.6)	-0.3 (0.6)	-0.3 (0.6)
Mean log (arithmetic)	0.91(8.1)	0.71 (5.1)	0.56 (3.6)
Maximum (arithmetic)	2.62 (417)	1.48 (58)	1.12 (13)

[a-b] Counts are not significantly different (p=0.320)

[a-c] Counts are marginally significantly different (p=0.665)

Table 2: Minimum, mean and maximum log and arithmetic counts/cm^2 obtained from cleaned knives at the bunging stand using the current and Econoliser systems

	Current [a]	Econoliser 4s [b]	Econoliser 6s [c]

Minimum log (arithmetic)	0.12 (1.3)	-0.1 (0.8)	0.0 (1.1)
Mean log (arithmetic)	0.99 (9.8)	0.77 (5.9)	0.59 (3.9)
Maximum (arithmetic)	1.96 (92)	1.33 (20)	1.27 (18)

[a-b] Counts are not significantly different (p=0.123)

[a-c] Counts are highly significantly different (p=0.006)

In terms of *E. coli*, the faecal indicator organism was isolated on three occasions, only from knives decontaminated using the current system at the bunging station; *E. coli* was not detected from any of the other 117 knives tested.

An alternative way of presenting the data is shown in Figures 1 and 2 for counts obtained at legging and bunging, respectively where counts are grouped into categories ranging from <1 cfu/cm^2 to >1000 cfu/cm^2.

As can be seen from both figures, the distribution of counts is generally skewed towards the lower categories (<1 cfu/cm^2 and 1-10 cfu/cm^2) for knives cleaned in the Econoliser units, particularly in the case of the 6-second cleaning time.

4. Discussion

In evaluating the results described above it should be emphasised that the cleaning result of knives rinsed and then placed in the decontamination unit is dependent on several factors:

1. The temperature of water used for decontamination
2. The residence time of decontamination
3. The presence of residues, particularly fat on the knife at entry to decontamination
4. The bacterial loading on the knife at entry

In the present trial factor 1 (water temperature) was the same for both systems, but all other factors were subject to operator variability in completing tasks at legging and bunging, plus the microbiological condition of the tissues being incised. However, the present trial provides evidence that the Econoliser unit with 4-second and 6-second sprays can decontaminate the knife at legging and bunging to an extent that is at least equivalent to the current method used in Australian abattoirs.

Fig 1: Percentage distribution of APCs on cleaned knives at the legging stand

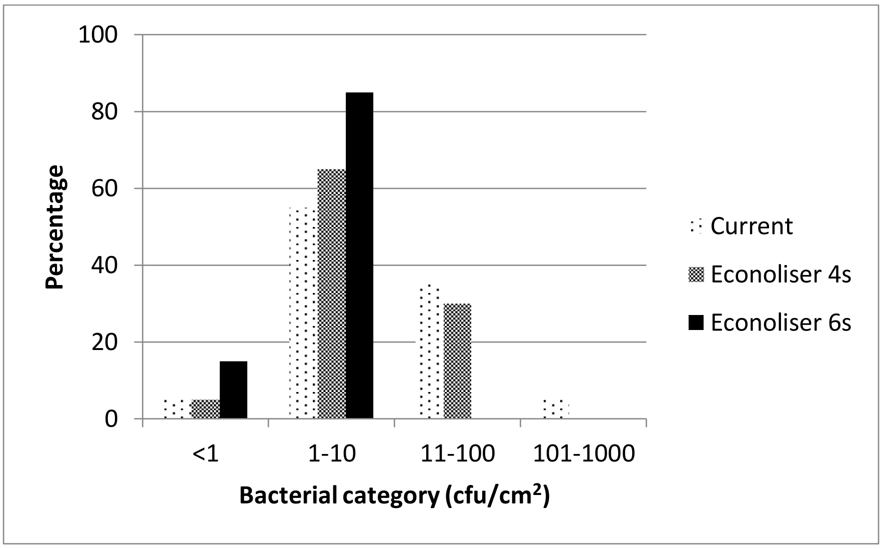
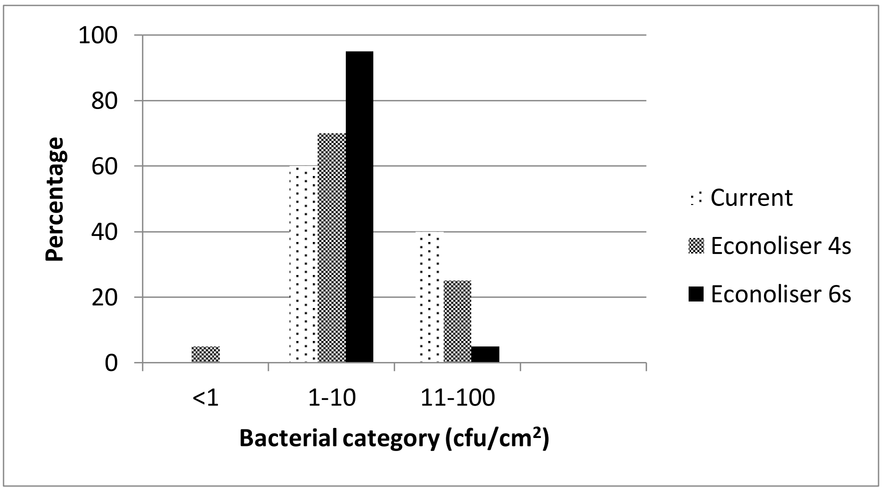


Fig 2: Percentage distribution of APCs on cleaned knives at the bunging stand



References

Eustace, I., Midgley, J., Giarrusso, G., Laurent, C., Jenson, I. and Sumner, J. (2007) An alternative process for cleaning knives used on meat slaughter floors. International Journal of Food Microbiology 113, 23-27.

Eustace, I., Midgley, J., Small, A., Jenson, I. and Sumner, J. (2008) Knife sanitizing in abattoirs: the effectiveness of current and alternative practices. Food Protection Trends 28:712-722.

Goulter, R. Dykes, G. and Small, A. (2008) Decontamination of Knives Used in the Meat Industry: Effect of Different Water Temperature and Treatment Time Combinations on the Reduction of Bacterial Numbers on Knife Surfaces. Journal of Food Protection 71: 1338-1342.

Horchner, P. (2007) Technical support on the application of <82°C water for knife and equipment sterilisation. MLA Report PRMS.084 V1. North Sydney, NSW 2029.

Midgley, J. and Eustace, I. (2003) Investigation of alternatives to 82°C water for knife and equipment sterilisation. MLA Report PRMS.037. North Sydney, NSW 2029.

MLA, Meat and Livestock Australia. (2007). Water at less than 82°C for sanitizing knives and equipment in abattoirs: a guide to gaining regulatory approval. MLA, North Sydney, NSW, 2059.

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