Results for today; Ideas for tomorrow

Meat Technology Update

Newsletter 1/05 *February 2005*

Water reuse in the meat industry—opportunities and issues

Water will be in critically short supply for more than a third of the earth's population during the 21st century. By solving our own problems, as well as we will not only help Australia—we can also contribute ideas and technologies for addressing one of the most vital aspects of human survival.

***Dr Peter Dillon*, CSIRO Land and Water**

Recent drought conditions and the potential for restriction on water supply over much of Australia have focussed the attention of many people on methods to reduce consumption of water in abattoirs. The reuse or recycling of water within a meat processing operation is potentially an effective method of reducing demand for fresh water and also reducing the quantity of effluent to be treated and discharged.

There are large volumes of water that are suitable for reuse. For example, an abattoir working two shifts with 40 knife and equipment sterilisers and a moving top viscera table will use over 280,000 litres of water per day for sterilising and cooling.

Many possibilities for reuse of water have been suggested. This newsletter examines some of these examples and provides some basic economic analyses.

Reuse opportunities

There can be a wide range of possibilities for reuse of water in abattoirs and meat plants. An analysis was recently done (under an MLA-funded study) on several reuse possibilities for waste water from abattoir processes, in order to establish their economic viability. The reuse options considered were:

1. water from knife and equipment sterilisers to wash cattle and yards;
2. viscera-table steriliser and cooling water used for paunch initial emptying or initial viscera-table rinse;
3. slaughter-floor steriliser and handwash water used for non-potable uses;
4. knife and viscera-table steriliser and handwash waste reclaimed using distillation equipment for feed back to sterilisers;
5. edible-offal wash water used for stockyard and truck wash; and
6. treatment of final effluent by membrane technology to Class A reclaimed water suitable for high quality reuse off site.

Estimates were made of the capital and running costs per site for each reuse application and the number of plants in Australia that could participate. Net present value (NPV) after 15 years and payback period were calculated for each reuse scenario based on replacement of potable water for that application.

Assumptions were made regarding cost of water and treatment as follows:

- The potable water supply to the plant is unlimited.
- Average quantity of water used is 11 kL per tonne HSCW.
- Average purchase cost of water is $0.75 per kL.
- Cost of treatment and pumping around the site is $0.20 per kL.
- Cost of treating the effluent for disposal to:
  - a) sewer $0.50 per kL;
  - b) surface water $0.80 per kL;
  - c) land $0.30 per kL.
- Plant operates on a single shift on 250 days per annum.

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Regulatory aspects

Regulations under which meat-processing plants operate in Australia have specific requirements with regard to use of non-potable water and reuse of water. The Australian Standard for Hygienic Production of Meat and Meat Products for Human Consumption (AS 4696:2002) restricts the use of non-potable water to circumstances where there is no risk of the water coming into contact with meat or meat products. Specific applications are:

- steam production
- fire control
- cleaning of yards
- washing of animals (other than the final wash) and
- other similar purposes not connected with meat and meat products.

The new Export Control (Meat and Meat Products) Orders generally follow the requirements of the Australian Standard with regard to reuse of water. Under the approved arrangement for a plant, there is scope for various alternative procedures to be approved. Provided the wholesomeness of the product is not jeopardised, reuse of water may be approved for certain processes.

Importing country requirements also impact on Australian export operations. The United States Food Safety and Inspection Service (FSIS) allows reuse of water under certain circumstances such as water to wash raw product may be reused for the same purpose provided measures are taken to prevent contamination or adulteration of the product. The FSIS also allows use of reconditioned water that has not contained human waste, provided it meets the criteria of the National Primary Drinking Water regulations; however, product, facilities and equipment that come into contact with this water must undergo a separate final rinse with potable water.

The European Union currently requires that potable water be used for almost all washing and rinsing operations, which limits the scope for the reuse of water within meat plants.

Slaughter-floor knife and equipment steriliser waste

The flow rate through individual knife sterilisers can vary markedly from less than 1 L/min to about 10 L/min depending on the valve setting required for size of steriliser, necessity to clear fat and hair, and whether it is insulated. The average flow rate is in the region of 4 L/min. Most steriliser overflow water is only lightly contaminated if at all and, because of the high temperature, should be free of pathogenic bacteria. The major expense involved in collecting this water is the drainage pipework to bring all the individual steriliser drains to one point where the water can be collected and pumped to the reuse site such as the yards. A suitably sized collection tank to pump from, and a storage tank at the yards as well as pumps and pipework, would also be required.

This option for collecting water for reuse is clearly most suitable to plants that have access to the area below the slaughter floor. The steriliser waste water is available in a quantity and quality suitable for several tasks including initial washing of cattle and washing down yards.

Viscera-table steriliser water

A large quantity of water is used to sterilise and cool moving-top viscera tables. The quantity reported varies widely but has been measured to be in the order of 50 L/min for steriliser sprays and a further 35 L/min for cooling water sprays. The water can be relatively clean; however, blood can drip through onto the back of the returning slats, and pieces of fat can become wedged between the slats. This blood and gross particles are then washed out by the steriliser sprays resulting in discolouration of the water and contamination with fat. Steps can be taken to reduce this contamination through changes to the design of the viscera table and adjoining structure.

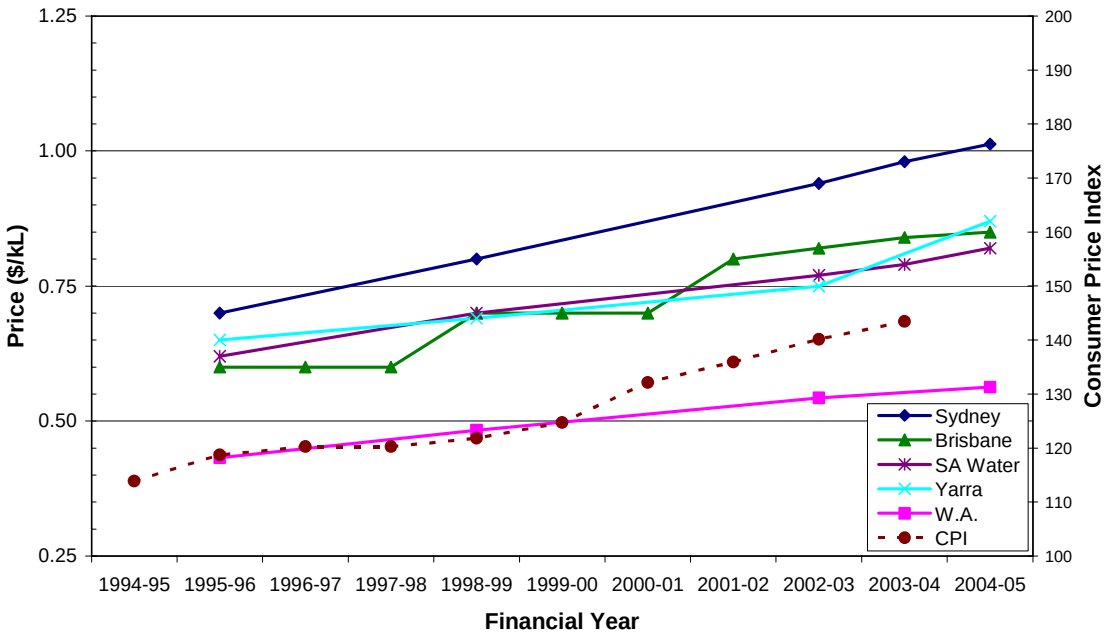

Figure 1. Residential water prices (based on an annual usage of 350 kL)

When collected, this water may be suitable for use as an initial rinse of the viscera table, or initial rinsing of paunch contents when they are wet dumped, or other uses.

Steriliser and handwash-basin waste

Handwash basins on the slaughter floor are normally in close proximity to sterilisers, therefore it would be relatively easy to include their waste with flow from the sterilisers. The higher flow rate should make collection more viable; however, the water is at lower temperature (~40ºC) and is unlikely to be sterile. It may therefore be more difficult to obtain approval for its reuse, even in areas such as yard and stock washing.

Distillation technology to treat steriliser and handwash water

Commercial distillation equipment is claimed to be able to produce near potable quality water from waste water. The steriliser and handwash-basin waste water should make an ideal feed as it is lightly contaminated and is already at an elevated temperature which would reduce the cost of heating from ambient temperatures. The output from the unit may be pure enough to form a portion of the feed to the steriliser water-heating system.

Distillation is normally regarded as being an expensive process and is generally only considered for use in areas where there is a drastic shortage of potable water. Capital cost of the equipment can be high, but the operating costs may be reduced if waste heat is available.

Edible-offal wash water

Edible-offal sprays often run continuously and the resultant effluent stream can be lightly contaminated. It is generated in a relatively compact area, therefore collection may not be difficult; however, it is also at ambient temperature, which means that it will not be sterile—so the options for utilising this water may be limited.

Treatment of final effluent by membrane technology

Effluent from abattoirs that has received primary and secondary treatment can be discharged to sewer, surface waters, or most commonly used for irrigation. In some circumstances the treated effluent may be reused for higher value purposes after further treatment. Most Australian States recognise four categories of reclaimed water (A, B, C and D). The highest category – Class A – may be used for purposes such as primary contact recreation, residential non-potable and municipal use with public access. Class A reclaimed water can be produced by microfiltration followed by disinfection with UV.g

Water recycled from sewage treatment plants is being used more commonly in communities around Australia. There is great variability in the pricing structure with the price charged for Class A water ranging from about 30% to 85% of the potable water price where it is used for residential supply to toilets and gardens. A price of 75% of the potable water price was assumed for calculation of the payback period.

Economics

The payback period calculated for each option (Table 1) indicates that under the current average water price, none of the options is outstandingly attractive; however, this assumes that abundant potable water is available to the processor. In Australia, it is clear that this is often no longer the case. Where a processor is constrained by the lack of potable supply, the conclusions below may not apply. In this instance the payback period may well be much less since reuse will permit additional production capacity.

It is clear that in cases such as distillation and membrane treatment, where a large capital investment has to be made and operating costs become significant, the water reuse option cannot be economically justified given the assumptions of this study.

Table 1: Estimated payback period for various reuse options

Reuse Option	**Payback (years)**
Steriliser water to yards	**5.5**
Viscera table to paunch	**3.5**
Steriliser + handwash	**4.9**
Distillation treatment	**>15**
Edible-offal wash water to non-potable	**3.9**
Membrane treatment of final effluent	**10.9**

Water pricing

Water prices can vary markedly between different water supply authorities. For example, in New South Wales in the financial year 2002/03, prices for non-residential high users ranged from $0.20 to $2.68 per kL. Most utilities charged between $0.40 and $1.00 per kL to large users. Prices charged to non-residential users are difficult to obtain. Prices to residential users are similar and sometimes slightly lower than non-residential prices; they are more readily available.

From 1994-95 to 2002-03 water usage prices charged to residential customers by major Australian water supply authorities increased at a rate of about 25% which was slightly above the increase in the consumer price index for that period of about 19% (Figure 1). Prices have continued to increase at about 3% per annum compared with the CPI increase of 2.5 to 3% per annum; however, some authorities have committed to increasing water prices at a rate greater than the CPI in order to meet revenue requirements and encourage customers to manage consumption.

The price paid for potable water has a strong influence on the viability of any water reuse proposal. Figure 2 shows the effect of the purchase price of water on the payback period for reusing water from sterilisers and handwash basins. At the current average price of $0.75 per kL the payback period is about 5 years whereas this is reduced to less than 3 years at higher current prices of $1.50 per kL. This is based on the assumption that other costs such as effluent treatment and pumping costs remain unchanged.

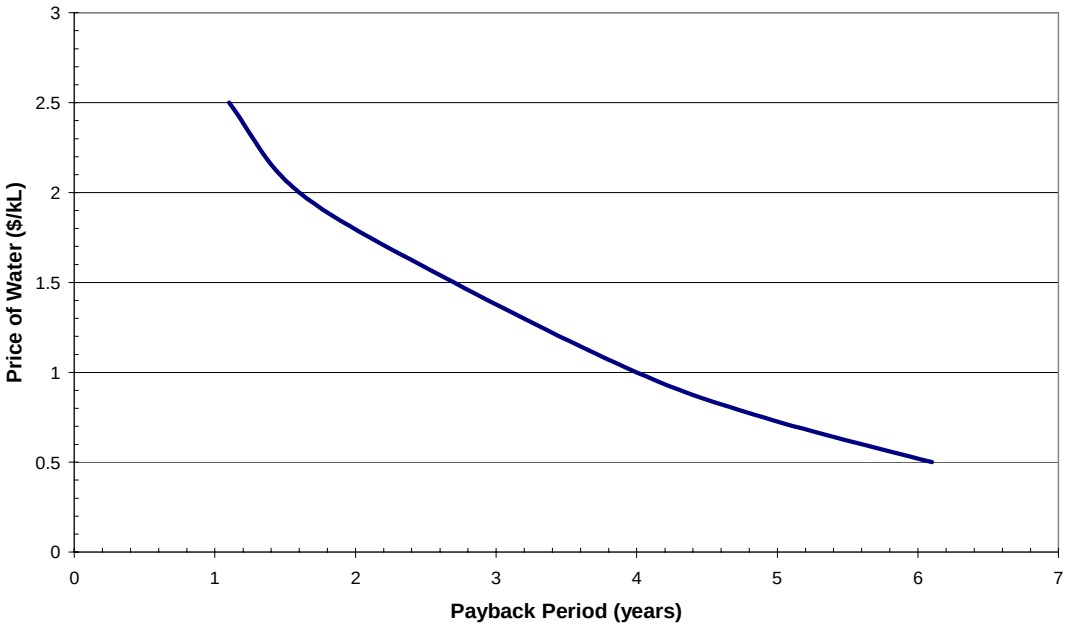

Figure 2. Effect of water purchase price on payback period for reusing water from sterilisers and handwash basins

The water reuse applications where there is no treatment of the water require the purchase price of the potable water to be $1.50 per kL before a payback period of three years or less is achieved. Where high capital costs and significant running costs are involved such as with distillation, the payback period is still in excess of 10 years even if water costs $2.00 per kL.

As stated earlier, water prices have historically increased at a rate close to the rate of increase in the CPI. Provided they continue to increase at this rate, it is unlikely that water reuse processes that have high capital and operating costs will ever be economically viable for the majority of plants. Only if there are dramatic increases in water charges or reductions in treatment costs would such processes become viable.

There may be plants however where there is a restriction on the supply of potable water and purchase and disposal charges are high which would make several of these reuse options more attractive.

'We've got a shortfall, so we need to be creative. Better predictions, demand management, reuse and recycling, smarter technologies and desalination can all be part of the response.'
– Carol Howe, leader of CSIRO's Urban Water project.

The information contained herein is an outline only and should not be relied on in place of professional advice on any specific matter.

For more information, contact one of the Meat Industry Services staff listed below.

Food Science Australia Meat Industry Services

Meat Industry Services (MIS) of Food Science Australia is an initiative supported by Meat and Livestock Australia (MLA) and the Australian Meat Processor Corporation (AMPC) to facilitate market access for, and support world-class practices in, Australia's meat industry.

Need additional help, information or advice? *Contact one of the following:*

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