ALAN J. JONES FRACI C CHEM

Innovation: from outside privy to toilet suite

Alan Jones profiles recent innovations in toilet suites, with regard to water resource conservation and environmental management, and led by the company Caroma, a wholly owned subsidiary of GWA International Limited.

Toilet terminology

A remarkable number of terms describe the devices/mechanisms used to dispose of bodily wastes. In Australia, the most popular term in the vernacular remains the 'dunny', which, according to the ABC's Word of the Day[1] derives from the 18th-century word *dunneken*. The last syllable probably refers to a source meaning 'house', while the first syllable is probably related in some way to 'dung'. The *Oxford English Dictionary* defines a 'dunny' as an earth closet, or an outside privy, hence the derivative terms *closet*, later *water closet* or *WC*, and *privy*. Associated with these terms we also see the emergence of the use of water to 'flush' away the wastes; some of us can still remember being reminded to pull the chain attached to the cast iron overhead box.

The more formal terms *lavatory* and *toilet* have their origins as a place or vessel for washing and a dressing room, respectively, although both have also evolved to describe the place or vessel in which the waste disposal occurs. Interestingly, the British aristocracy originally used *toilet* in this context to distinguish themselves from the proletariat, who were designated to use lavatories or latrines. Returning to the vernacular, we cannot avoid mentioning terms such as *out-house*, *lav*, *loo* (said to derive from the old English *hleow*, meaning 'small shelter'),[2] *bog*, *throne*, *khazi* (derived from the Italian *casa*, meaning 'house or cottage') and *crapper* (derived from the British plumber Thomas Crapper who is said by some to have invented the flush toilet – he certainly sold a lot of them worldwide with his name emblazoned on them).

For those who haven't read it, I recommend the short story *The Specialist*.[3] As chemists we all know how we develop specialist skills, but Chic Sale's wonderful piece of 1929 describes the activities of a privy-builder (e.g. wooden, one to three-holer, back yard variety). Another book of this genre is Fred Hillier's 1993 epic, *Further Down the Back*, a celebration of the great Australian dunny.[4] If you want a good laugh, *The Dunny Poem* is highly recommended.[5]

Today, we take for granted the flush toilet bowl, be it attached to a wastewater system running to the sewage works, or to a localised septic tank. Some of you may not be aware that for many years the water cooling towers of power stations were cooled using sewage water, but this practice ceased due to the buildup of heavy metals in the final treatment plants, before release of the water to creeks, streams, rivers and the seas.

Since its foundation in 1941, the Australian company Caroma, which specialises in sanitary products, has been dedicated to product design and innovation in toilet systems with the aim of minimising water usage and the amount of effluents. Successes in this area are truly contributions to green chemistry.[6]

About Caroma

Caroma is one of the six divisions of Brisbane-based and Australian-owned GWA International Limited, which listed on the Australian Stock Exchange in 1993. It is one of Australia's largest designers, manufacturers, importers and distributors of household consumer products. The group comprises Caroma, Dorf Clark, Dux, Gainsborough, Rover and Sebel, and in 2004–2005 employed more than 2400 people in major manufacturing facilities throughout Australia and in Europe. Caroma itself has about 40 people in R&D working in Wetherhill Park, Sydney, and Norwood in Adelaide.[7]

The GWA Group has consistently recorded an operating revenue in excess of $600 million for the past six years ($648 million in 2004–2005) and reported a record operating profit before tax of $91.5 million in 2004–2005. R&D expenditure was about $6.5 million in 2004–2005, representing a continued commitment to R&D of about 8–10% of turnover per annum over the past six years.[7]

The dual-flush system

A considerable body of evidence suggests that heated bath systems, ducted water heating systems and the equivalent of flush systems for disposing of bodily wastes were available to the ancient Greek and Roman civilisations. Sir John Harington is said to have devised the first British flushing toilet in 1596, called the Ajax, derived from 'a

Dr Alan Jones is Adjunct Professor of Innovation, Management and Performance Management in the Division of Business, Law and Information Sciences (BLIS), University of Canberra; and Visiting Fellow, National Graduate School of Management, Australian National University.

Table 1. Annual water saving from Smartflush compared to existing systems[9]

Existing toilet suite	Annual water usage of existing suite (L)	Annual water saving by upgrading to Caroma Smartflush (L)
11 litre single flush	50 188	35 130
11/5.5 litre dual flush	30 113	15 055
9/4 litre dual flush	24 638	9580
6/3 litre dual flush	16 425	1367

jakes' (*jakes* being an old English slang word for toilet). However, flush toilets as we know them today have only been around for about 200 years and their widespread use only commenced in the 20th century.

The traditional water closet flush system requires a lot of water, and large volumes of sewage need to be piped away and hopefully treated. An article in the series Australia Innovates,[8] produced by the Australian Academy of Technological Sciences and Engineering in conjunction with the Powerhouse Museum, notes that the average Australian toilet uses 11 litres of water for each flush, and some companies make toilets with two flush volumes. It is also noteworthy that Sydney, like many other coastal cities, was built with its sewage system flowing towards the sea, which was perceived as a large diluent pond for waste waters, until relatively recently.

From the mid-1980s, overseas visitors to Australia often marvelled at the fact that many Aussie toilets had two flush buttons to choose from – the dual-flush toilet originally developed by Caroma was introduced to the market in 1982. Caroma is a world leader in dual-flush systems, and in 1993 introduced their six litre (full-flush) and three litre (half-flush) toilets, which also produce less sewage than conventional toilets. The environmental consciousness of the world was seeking to conserve water and reduce pollution, and the Caroma system addressed these problems simultaneously.

However, the development of the dual-flush system was not simply plugging a new flush cistern on to an old toilet design. As noted in the Australia Innovates article,[8] 'the 6/3 litre system was designed from scratch at development costs running into several million dollars, and involving redesign of the cistern and the bowl/pan, the latter to ensure that the toilet flushed properly'. The design and development processes started in the late 1970s, and notably employed CAD-systems to produce images to fit the design concepts. These images were then trialled with potential buyers. Modelling and extensive R&D formed the basis for producing the final cistern and pan products and, as the article notes, while a major change in design of cistern parts occurs about every 10 years, minor changes occurred about once a month during this development phase. All products and components produced by Caroma comply with world's best in manufacturing and environmental practice, meeting the ISO 9001 and ISO 14001 standards.

Smartflush

In September 2004, Caroma announced the introduction of another innovation in water flushing technology, the Caroma Smartflush®.[9] This innovation follows five years of intensive R&D effort (expenditure of about $1 million) to address the ever-growing demand for water conservation, expressed by both governments and the community in Australia.

Like its predecessor dual-flush system, the Caroma Smartflush uses less water – down to just 4.5 litres for the full flush, while maintaining the three litre half-flush – and is estimated to save the average home up to 35 000 litres of water per year at no extra installation cost or complexity. The number of litres saved per average home depends on the toilet suite currently installed (some estimates are provided in Table 1).

In the case of the Caroma Smartflush the standard toilet suite technology was re-engineered to

deliver more energy from less water; this included the redesign of the flushing valve in the cistern, reshaping the pan to streamline flow, and ensuring that the cistern, pan and trap work together as a uniquely optimised unit.

At a time when Australia has experienced some of its worst droughts on record, this latest innovation according to Caroma 'has the potential to quietly revolutionise water consumption habits across Australia and around the world'. Since its introduction, the Smartflush technology has been recognised for its environmental qualities by the Water Services Association of Australia, who awarded the Smartflush suites a '4A' water rating efficiency. It was the first such technology to obtain such a high rating in Australia. The product has also been recognised for its environmental qualities by the award of 2004 Product of the Year (Green Plumbers Award), an Australian Design Award, 2005 National GreenSmart Product of the Year Award (Housing Industry Association), Award for Excellence in Engineering Design (highly commended; Engineers' Australia) and the Powerhouse Museum Selection Award.

According to a report by the Department of Environment and Heritage,[10] Caroma International, the export division of Caroma Industries Limited, was established to service the world market. Caroma products, including the 6/3 litre dual flush system, are shipped to more than 30 countries worldwide, and the 4.5/3 litre system to Singapore to date.

References

1 Dunny. ABC Classic FM, Classic FM Breakfast, Word of the Day, Friday 5 September 2003, at www.abc.net.au/classic/breakfast/stories/s939441.htm

2 Up from Australia, http://upfromaustralia.com.takepeebreak.html

3 Sale C. *The Specialist*. Putnam & Company, London, 1929; available online at www.jldr.com/specialist.htm, or at www.chicsale.net

4 Hillier F. *Further Down the Back*. HarperCollins, Sydney, 1993.

5 *The Dunny Poem*, www.australianoutdoors.com/dunny%20poem.htm

6 Jones A.J. Interview with the founder of green chemistry. *Chem. Aust.* 2005, **72**(5), 4–7.

7 *Built on Strong Brands*. GWA International Limited 2004/05 Annual Report. Brisbane, August 2005.

8 Caroma dual flush toilet – made in quantity while maintaining quality. *Australia Innovates*, www.powerhousemuseum.com/australia_innovates/make.html

9 Caroma Smartflush Toilet Suites, www.caroma.smartflush.com.au/n_pro070904.html

10 Design for environment – Caroma dual flush. Department of the Environment and Heritage, www.deh.gov.au/settlements/industry/corporate/eecp/case-studies/caroma-dfe.html