Moving beyond the 'yuck factor': the challenges of water reuse

There has been a strong upward trend in the growth of wastewater reuse to overcome water scarcity issues, but the barriers of public acceptance, differences in national guidelines, and pricing have still to be overcome. **BILL McCANN** speaks to consultants involved with reuse projects worldwide about what they see as the trends and needed changes in the reuse market.

After a decade or more of a rising trend in reuse of treated wastewater, it is safe to say that the practice has become part of the mainstream. In resource planning the thinking has moved distinctly away from effluent disposal and towards reuse. At the same time, many of the earlier curbs to scheme implementation have yet to be fully resolved.

A lack of uniformity in national guidelines and regulations is a frequently-voiced concern, and pricing remains a thorny issue – the true cost pricing of 'first use' water and the reuse product, and rationalization between the two.

But, while these and similar issues have remained largely of interest within the industry, the headlines and public attention has focused on the smallest part of the market, planned indirect potable reuse. This generally comes down to the so-called 'yuck factor' – public distaste and inherent resistance to the very idea of drinking water that, at some stage, has passed through a wastewater treatment plant.

Particular constraints have more prominence in different regions of the world. In a recent brief snapshot of reuse trends and issues, John Charlton of Danish consultancy Grontmij Carl Bro refers to shortfalls in European Union (EU) legislation.

Speaking of the two most recent major water directives, the Urban Waste Water Treatment Directive, 20 years old this year, and the Framework Directive 2000/60/EC, he says both were sadly lacking in new concepts and directions on effluent production. 'Both of these directives need a greater focus on key issues such as reuse – and indeed that subject scarcely gets a mention, even though the Framework Directive aims to facilitate integrated water resources management,' he comments.

In his view, that, and the fact that Europe is not, overall, significantly water stressed, had limited development of reuse to date. Cyprus was an exception but he estimated that, in 20 major European wastewater projects prepared by his company in the last five years, the reuse component was less than 5%.

The municipal treatment plant at Peoria, Arizona, USA, where effluent is reused for aquifer recharge. Credit: Diego Ceja.

Public acceptance and uniform rules

Consultants active in the United States and Australia both highlight the 'yuck factor', better described as public acceptance, something that would only come with better and more consistent communication and education.

Speaking of the United States, Cindy Wallis-Lage, Senior Vice-President for Black & Veatch's global water business, says public antipathy stems from a lack of understanding about reuse and how it can, and must be part of, a larger water strategy. 'That means we need a common message, consistent communication to the public and consistent regulations,' she says. 'Unfortunately, we have 50 states with almost 50 different messages and 50 different regulatory requirements. The water sector needs to develop and deliver the reuse message to the public, and to the politicians, to encourage reuse as part of our long-term water supply solution. This message must include the financial value of water and the financial value of reclaimed water.

'We need to price potable water appropriately to reflect the true costs of transport and treatment. At the same time, we need to price reclaimed water appropriately. Providing a reduced price for reclaimed water could send a message of lower quality compared to potable water. The required end-use quality will always be met; the price should be a function of delivering the water at the required quality in a reliable manner.'

None of this would be disputed by Chris Hertle, Global Leader of the Water Division in Australia-based consultant GHD.

Australia similarly suffers from a lack of uniformity in regulations in the separate states, Victoria's rules being seen as particularly onerous and other states more realistic. Hertle points out that this not only adds to the initial cost of the plant, but also to the ongoing costs of compliance monitoring.

More positively, he notes that the traditional separation of the (potable) water and wastewater sectors – still administered through two separate national organizations in the United States – has long disappeared in Australia. 'We have just the Australian

Water Association and really do think of water holistically – water, wastewater, stormwater, industrial water, etc. That is why we have been able to develop the concept of integrated water management in Australia so well.'

Even so, as one of the early research efforts from the country's recently established Water Recycling Centre of Excellence (AWRCE – see box) indicates, the rationalization of state approaches to recycled water projects remains a significant issue. Some AUS$3 million (US$3.1 million) is being allotted to a multi-agency effort to develop a National Validation Framework for recycling. This is because, despite the existence of national guidelines for recycled water quality, each state and territory has its own approach to validation, often with different criteria and testing requirements.

The AWRCE is a forward-looking response to Australia's precarious water situation, unusual in having almost the entire population commonly under the threat of prolonged drought, occasionally interspersed with extreme floods.

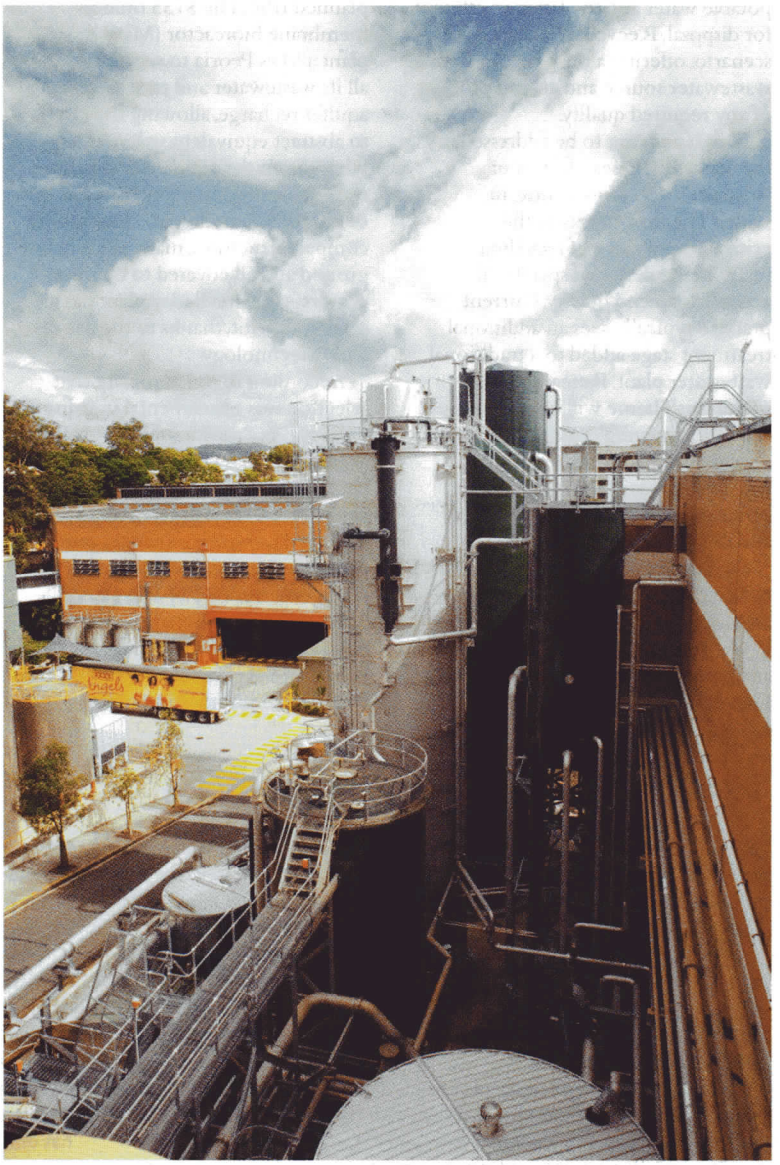
That has driven the development of the holistic approach to water management that Hertle describes, and latterly to the leading role in recycling that the country now occupies.

Changes in the reuse market

Coincidentally the Centre's launch appears to have come at a time of change in national recycling activity. Hertle estimates reuse schemes as currently occupying between 10 and 20% of GHD's water work, down from around 50% a few years ago. The mix has changed too, he says, with a move to more industrial projects and some smaller municipal schemes, in the 10Ml to 20Ml/day range.

'There are still some good opportunities in Australia, but we are not going to see any more like Western Corridor or the Melbourne Eastern Treatment Plant reuse – projects in the 100Ml/day range,' he says. 'Now the market is being driven by the increasing cost of water, and that will continue as the impacts of all the new desalination capacity feed into pricing.

'At the same time, the cost of recycled water systems is reducing as the technology improves. That offers the incentive for industry to treat and recycle process water for example. In the XXXX Brewery scheme (Milton, Brisbane) the treatment plant allowed the company to recycle 75% of all the generated wastewater and reduce overall consumption from four litres to 2.2 litres per litre of beer produced. They also had reduced trade waste charges and reduced consumption of cleaning chemicals – and biogas production from anaerobic digestion of the wastes gave them upwards of 10% saving on their daily demand for natural gas.'



High quality effluent for process reuse following an anaerobic stage, Circox fluidised bed aerobic treatment, dissolved air flotation and microfiltration / reverse osmosis at the Castlemaine Perkins XXXX Brewery. Credit: GHD.

In other contexts there is still seen to be a need to lower the costs of treatment for reuse. Charlton says the typically used technologies, such as reverse osmosis or ultrafiltration, are regarded as prohibitively expensive where the resource pressures are not extreme, and Wallis-Lage refers to the advanced oxidation treatments generally applied for control of emerging contaminants. 'Combining UV and peroxide or ozone is a very expensive treatment concept,' she says. 'We need more disinfectant research to develop cost-effective approaches when the end use demands contaminant control.'

Wallis-Lage estimates projects with a reuse element continue to feature in around 50% of the Black & Veatch wastewater order book and says there are major growth prospects in the USA, Australia, Singapore, Asia and the Middle East.

GHD also has the USA and the Middle East in view and, perhaps unsurprisingly, Hertle sees big future markets in China and India.

Reuse adapted to end use needs

As reuse markets develop across this very wide regional range the end quality requirements of the recycled product will vary accordingly, tailored to the local needs of agriculture, industry or non-potable uses in the urban sector. Only in that small part of the market directed at planned indirect potable reuse (IPR) will water of the very highest quality be required.

Wallis-Lage notes above that any required end use quality can always be met. That is because of the massive progress made in water and wastewater treatment technology over several decades. It is a progression that has nevertheless maintained the traditional separation of the 'clean' and 'dirty' water streams, the former delivering

potable water and the latter an effluent for disposal. Recycling changes that scenario, offering a third stream with a wastewater source and an end product of any required quality.

This is a matter to be addressed in the Strategic Research Plan of Australia's new reuse centre, in which Theme 1 points to the critical importance of recycling plants being designed specifically according to end quality. Current practice typically sees an additional treatment stage added to a traditional wastewater plant. Research effort under this Theme will be directed towards achieving optimal efficiency of plants in this 'third' stream, and full integration of these recycling plants into the space between clean and dirty water streams.

Such issues did not arise in the Black & Veatch design for an aquifer recharge project in Peoria, Arizona, USA, where the resource pressures are great and the need was for the highest quality output, suitable for planned IPR. The $135 million membrane bioreactor (MBR) plant allows Peoria to reclaim all its wastewater and treat it for aquifer recharge, allowing the city to abstract equivalent volumes elsewhere from the aquifer for potable use. Incorporating many features of modern plant design – low profile compact structures, many units below ground and all covered to confine odours – the 40Ml/day plant has a small footprint, thanks to the use of MBR technology.

According to the company, that selection was instrumental in gaining public acceptance, a subject on which Wallis-Lage has very definite views: 'If a message about water supply issues and alternatives is developed and delivered early, and facilitates public participation and education, there is a stronger likelihood of acceptance.'

Referring to a remark in the company's recent white paper (Global Barriers to Reuse), she says 'sugar coating' the information creates mistrust. 'The key is open and honest communication in combination with solid scientific data,' she says.

With the experience of the Western Corridor recycling project in mind, some in Australia might ask if that is always enough but, overall, there is substantial agreement across the international industry on the way ahead, and the research needs, if the expanding reuse sector is to be developed sustainably.

The Black & Veatch white paper was developed over roughly the same period as AWRCE was developing its Strategic Research Plan, and was launched last year only shortly after launch of the Centre.

Mark O'Donohue, Chief Executive of the Centre, notes the close agreement between the key needs expressed in the paper and those in the Centre's published Goals. In his words: 'We support the findings of the B&V paper. Our Goals 1, 2 and 3 are closely aligned with three of the four priorities they identify.' ●

Australian Water Reuse Centre of Excellence

The Australian Water Reuse Centre of Excellence was launched in March 2010 with AUS$20 million (US$21 million) of Federal Government funding and the organizational support of a Chief Executive and a small Research Advisory Committee (RAC).

With the primary objective of establishing a national research programme in water recycling, the preliminary steps had already been taken when discussion papers on four Research Themes were developed in consultation with a comprehensive range of national water sector interests and with some international input.

Development of each paper was co-ordinated by a member of RAC and all four were released as the Centre was launched. The themes are:

- Theme 1: Technology, efficiency and integration
- Theme 2: Water quality and scheme validation
- Theme 3: Social, economic and institutional challenges
- Theme 4: Sustainability in water recycling

Over the following months, in order to develop an initial Strategic Research Plan (SRP), further comment on the discussion papers was sought from the national water recycling community. Additional feedback came also from a series of workshops convened at urban and regional centres throughout Australia, during a countrywide tour by CEO Mark O'Donohue and Ian Law, Chair of RAC.

While the initial discussion papers had identified perceived gaps in current research programmes, these later inputs highlighted those research topics seen by the industry as having the highest priority. Additionally, this stage allowed the identification of a number of operational goals that the Centre could support in the early years of the investment programme.

These four goals are built into the now published SRP, underpinning the basic concept of progress towards an expansion of environmentally, socially and economically sustainable recycling through industry / research partnerships with practical, measurable outcomes.

The goals are:

- Goal 1: The social / economic / environmental value of water recycling is demonstrated and enhanced.
- Goal 2: A national validation framework for water recycling is established.
- Goal 3: Reclaimed water is seen as an acceptable 'alternative water' for augmenting drinking water supplies.
- Goal 4: A national knowledge, training and education programme for water recycling is established.

The SRP describes how the 19 priority research topics relate to the themes and goals. Some topics, for example 'Management of salts and saline effluents', are indicated as relating to a single goal (in this instance Goal 1). Others, such as 'Optimal integration of water sources, users and technologies' are relevant to Goals 1,3 and 4, and the topic 'Knowledge management and a consistent approach to implementation' has a bearing on all Goals.

By April, three rounds of project funding had already been completed, the first two financing projects in support of Goals 2 and 3, and the most recent directed at Goal 1. Like the earlier rounds it has been allocated up to AUS$3 million (US$3.1 million).

It is a measure of the interest in, and support for, the Centre and its objectives that this Goal 1 round attracted 38 proposals. At the same time, the project just started under Goal 2, to establish a national validation framework, has drawn in additional financial support from Dow Chemicals and both Water Quality Research and the Water Services Association of Australia.

The successful project team consists of over 20 organizations, including national research body CSIRO, a number of leading universities and state regulators, utilities and manufacturers.

O'Donohue is quite clear that such practical and financial support from all these sectors is essential if the Centre's objectives are to be met. The Commonwealth has funded the establishment of the Centre and core funding to initiate projects but, in his words: 'While the Centre is making significant investment in the delivery of the four goals, they cannot be achieved without the intellectual and financial support of the broader water recycling community. Accordingly, we are seeking industry to be involved in all our projects, and to contribute to and support those applied projects commissioned by the Centre.'

He goes further, drawing attention to the relevance of this initiative to the international recycling community. Formation of the SRP drew on international inputs, and the published Plan includes an extensive review of recycling experience outside Australia.

He feels strongly that those connections should be strengthened and expanded and extends a welcoming hand. 'If there are companies or industry sectors outside Australia interested in participating in the first two funding rounds (Goals 2 and 3), the Centre would be happy to put the interested parties in contact with project leaders and discuss how they may contribute to successful project outcomes.

'We will be at Singapore Water Week and at the International Desalination Association conference in Perth later this year, and will be happy to discuss the Centre and its activities further,' he adds.

Further information: www.australianwaterrecycling.com.au