Floating new ideas

China has embraced floating reedbeds to treat stormwater and come up with some innovative projects. Tom Duncan explains a natural technology and opportunity.

More than half the world's population now lives in urban centres, exerting pressures that are making it difficult to fit large water treatment systems into the dwindling and expensive land supply. Intensive treatment systems that offer a small footprint and low cost will continue to grow in popularity. They could even include a biomass energy component as government and industry strive to develop a way forward for low carbon economies.

Over the past five years Aqua Biofilter has been researching and developing solutions for the booming markets in industrial, rural and urban wastewater and also stormwater.

The technology is a system of floating reed beds for lagoons, wetlands, lakes and ponds. Floating biofiltration technologies and design strategies have been refined internationally and used in some innovative ways, particularly in China.

While the Chinese have deployed floating reed beds on a massive scale, one of their key selling points is an ability to deliver clean water at an affordable cost and minimal footprint. Some 200m²of Aqua Biofilter reed beds can treat the equivalent of one hectare of conventional treatment wetland.

This significant cut in system size is attractive because cost and land availability always impact on new projects, while upgrading older lagoons and wetlands can be difficult and expensive.

Maintenance-free once established, the Aqua Biofilter has been proven to dramatically improve quality of stormwater, sewage and agricultural and industrial wastewater, including dairy, mining, food and beverage processing, abattoirs and aquaculture. It also has applications for golf courses, lakes, rivers, natural billabongs and aquatic ecosystems.

It has been used in stormwater wetlands in Bega NSW and drinking water reservoir remediation in China. One particularly innovative example is a sewerage treatment system in a new city precinct of Nanjing, China, where fast growing biomass is fed into anaerobic digesters to provide power and heat for the precinct – a truly sustainable city solution.

China's combined stormwater and sewerage system covers more than 10,000m².

The living reed

The floating reed beds are made of safe materials that are proven to be stable in the aquatic environment.

The mechanism for the treatment of nutrients, metals and minerals is via the root zone exerting a strong algal and bacterial biofilm that acts as a fine mesh through which the wastewater or stormwater column passes, shedding its pollutant load on to the sticky biofilm. Pollutants pass into the plant via the biofilm on the roots, accelerating the plant's growth.

Further processing occurs under mixed aerobic and anaerobic conditions inside the root zone and is then further metabolised by the associate biofilms, transferring nutrients, minerals and metals into the roots and shoots of the plant.

Denitrification also occurs under anaerobic conditions within the root zone and under the floating reed beds, effectively reducing the nitrogen from the wastewater or stormwater to the required treatment performance levels. These can be determined according to system design.

I presented at the National Stormwater Industry Association conference last month on a trial we ran with Bega Council in southern NSW. A single wetland receives most of the stormwater from the town's 60 hectares of urban and semi-urban catchment. It is high in nutrients and pollutants, which are dumped in a 7m deep anabranch wetland.

In 2007, an Aqua Biofilter was installed at the stormwater entrance, a 2m wide open outlet. The dense root mass of the 200m² floating reedbed was directly in the stormwater stream, intercepting the polluted flows and mopping up the majority of the nutrients, suspended solids, metals and toxicants.

The wetland contained threatened species and bioregional significant species, making species selection an important aspect of the project. It was decided that a mix of the following plants would be suitable, namely Bolboshoenus, Baumea, Carex and Juncus.

Carex was the most successful. After 14 months, the small 30cm plants had grown to a whopping 2.2m length, including roots. Root tissue lab analysis revealed

a significant uptake of the pollutants (see Fact File), indicating the almost hydroponic nature of the plant growth enhanced their ability to uptake colloidally suspended minerals, nutrients, metals and toxicants.

Some doubted the ability of a floating reedbed to withstand floods and extreme storm events, but when a flood raised the wetland anabranch water levels by 7m, the Aqua Biofilter and its plants continued to power away, anchored to the wetland floor but able to rise and fall with the flow of the flooded wetland.

Chinese take-aways...

Sustainable city development can be achieved in a number of ways. In China, the Aqua Biofilter team worked on a highly urbanised, on-site combined sewage and stormwater treatment system, with large impervious catchment feeding into the waterways.

Sewage was directed into the anaerobic biodigester for treatment and then piped for further treatment in the lagoons, where the floating reed beds were installed.

FACT FILE

Bega plant trials

POLLUTANT	AT PLANTING	AT 14 MONTHS
Nitrogen	50mg/kg	+200mg/kg
Manganese	97mg/kg	7,700mg/kg
Iron	470mg/kg	42,000mg/kg
Copper	9.2mg/kg	23mg/kg

The resultant design was a plastic weir to collect gross pollutants and then floating biofiltration systems to mop up any suspended solids, nutrients and metals that remained after passing from the biodigester and stormwater system.

Another project was a large 67 hectare drinking water reservoir in China, in which toxicants were creating health risks, nutrients were fuelling toxic algal blooms and wind-wave action was resuspending solids, together degrading the water supply.

The solution was a zoning design in which floating reed beds were placed near the shore to prevent wave action stirring up sediment, and large scale versions were deployed across the reservoir to treat the toxicants in the water and reduce nutrients. The project is being replicated across China.

Floating biofilters offer a cheaper, reliable and flexible treatment train enhancement in the face of growing pressures on land, waterways and budget bottom lines.

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