

Innovative Reed Beds Treat Heavier Loads in Smaller Footprints

If you've already considered reed beds and believe they're not for you, read on and think again. Hi-tech innovations have opened up myriad new applications for this pinnacle in sustainable wastewater treatment. We asked **Tori Sellers**, director at the UK's market leader - **ARM Reed Beds** - to explain how.

Reed beds - a type of constructed wetland - have been used in municipal wastewater systems since the 1980s. But innovations are now widening their application to treat high-strength, industrial wastewaters such as landfill leachate, dairy waste, hydrocarbon contaminated groundwater and contaminated run-off.

Earlier generation passive reed beds had a limit to the efficacy of natural biological, chemical and physical forces to remove pollutants from different types of wastewater.

But that's all changed as wetland technology's taken a 'quantum leap' with Forced Bed Aeration™ (FBA™), according to Tori Sellers from ARM. FBA™ involves laying a network of pipes below the gravel matrix which bubbles air through the system increasing the oxygen availability providing greater treatment capability.

This relatively simple innovation means a sustainable technology is now available to a wide range of applications previously deemed unsuitable. Particularly difficult effluent loads can now be treated and often in small plots.

Just in time

"Changes in legislation are putting greater demands on the treatment of wastewater," says ARM's Tori Sellers. "Wastewater treatment systems are having to adapt to meet stricter water quality requirements.

"Reed beds have been used to successfully treat wastewater since the 1980s. Many water companies use them - Severn Trent is the largest using them at 370 sites to treat sewage and stormwater. Southern Water has the largest reed bed treating sewage in the UK and Thames Water the second at Berkhamsted.

"But it's over the past decade that reeds bed treatment systems have come into their own because they offer sustainability - with low energy requirements, minimal maintenance, and create habitat.

"Different environments call for different systems based on specific treatment requirements. Though they all work on the same basic principles, they are designed to cope with higher volumes or more concentrated effluents.

"We have successfully installed and operated them in a myriad of applications ranging from run-off from airports and distribution centres to the treatment of vegetable washing effluent and sewage."

USA and UK partnership

FBA™ systems were developed to improve upon efficiency of existing passive systems in the US by Naturally Wallace Consulting. Scott Wallace, president of Naturally Wallace Consulting, is the owner of several wastewater treatment system patents including FBA™ technology which he researched and developed.

Recently Scott has been appointed an advisor and process engineer to ARM. This partnership makes ARM the sole provider of FBA™ systems for wastewater treatment in the UK.

"Planning and logistical requirements to install a FBA™ system are very similar to those for a standard reed bed," says Tori Sellers. "Engineers carry out a flow and pollution load survey identifying the best treatment process for the specific effluent ensuring optimum efficiency from the start. The volume and nature of the wastewater, available space and upstream treatment processes being used are amongst several factors taken into account for the design."

Why FBA™ is more efficient

Oxygen availability is vital for microbial degradation of organic pollutants. It is used in this process and is therefore the determining factor in how effective a reed bed is at removing pollutants, particularly ammonia.



In FBA™ systems, a network of aeration pipes are laid below the gravel matrix. Air is then forced through these pipes enabling a constant flow to percolate through the system thereby increasing the oxygen availability. This boosts treatment capability by up to 15 times greater than that of a traditional passive reed bed. This also means that FBA™ reed bed treatment systems can treat heavier loads in smaller footprints than existing systems.

Installation costs for reed beds including those fitted with FBA™ is comparable to costs for other industrial wastewater treatment solutions, the saving however is made in energy consumption and operating efficiency.

FBA™ vs traditional reed beds

"Smaller footprints - 50 % smaller than traditional reed beds in some cases - are made possible by this new FBA™ technology accommodating a much deeper reed bed," says Tori Sellers.

"Unlike passive wetland technology, FBA™ systems are capable of treating stronger pollutants such as those with high ammonia concentrations. The reed beds can be divided into aerobic and anoxic zones allowing both nitrification and denitrification to remove nitrogen from the effluent completely.

"It's particularly useful in meeting AMP5 objectives to significantly improve operating efficiencies with upgrading existing systems. FBA™ can be retro-fitted to existing systems to improve treating capability."

Case Study 1: FBA™ decontamination

Whilst FBA™ systems are relatively new to the UK, the US cites many successful applications.

In Wyoming, USA, Naturally Wallace, a partner of ARM, uses this new technique to transform an extensive area polluted by oil spillages and sludge into a golf course. The site previously housed a petrochemical company that had been operating for almost an entire century. The reed beds remain in operation and blend seamlessly into the golf course landscape.

They designed and implemented a system that is capable, over a hundred year period, of treating up to 30 million gallons of contaminated groundwater, removing hydrocarbons and residual iron associated with petrochemicals. This saved the oil company in excess of US\$12 million compared to a conventional mechanical plant. In addition the lower operating costs are expected to save a further US\$23.5 million.

ARM is implementing FBA™ systems at UK airports. Firefighting foam and run-off from runway and aircraft de-icing are powerful pollutants which FBA™ has been proven to treat effectively.



Case Study 2: FBA™ treating wastewater

Sustainability, in terms of environmental performance, is very important to the National Botanic Garden of Wales.

Tori Sellers, director at ARM Reed Beds, explains: “The National Botanic Garden of Wales came to us last year with a challenge: upgrade their existing wastewater treatment system – an eleven-year-old Living Machine® and aeration tanks – to handle increased visitor numbers while saving energy and costs.

“Over the summer, a sensitive refurbishment programme was initiated which included the implementation of state-of-the-art FBA™ technology within the reed beds and the removal of the Living Machine and aeration tanks. The new system now takes up a far smaller physical footprint, has a bigger treatment capacity and will save the garden around £7,000 in energy and maintenance costs every year,” says Tori Sellers.

The project was completed in autumn 2010 and comprises a septic tank which feeds into a 128m² vertical flow reed bed system with FBA™ technology. The greenhouse that used to house the previous

system is now used for additional visitor attractions and the garden demonstrates and explains the new system as a part of the visitor experience.

Prince Charles – patron of the organisation – praised the garden’s environmental focus on a visit in September 2010. He commented on the need to “leave a legacy for future generations of a sustainable environment.”

The key to the future

In recent years, increasingly stringent regulations regarding water quality have been put in place. Several EU directives including the Groundwater Directive, Urban Wastewater Treatment Directive (UWWTD) and, ultimately, the Water Framework Directive (WFD), govern the way in which wastewater should be managed in the UK. These directives provide a framework for the protection and improvement of water bodies.

The Water Framework Directive focuses on preventing pollution incidents rather than clearing up pollution following incidents to protect and enhance the quality of their water bodies. All water bodies should meet or exceed ‘good’ ecological and chemical status by 2015 under the WFD.

Previously it was acceptable to discharge water containing higher concentrations of ammonia and other contaminants into the environment however the directive will tighten the tolerances of these effluent discharges. Many existing treatment systems are unable to achieve these consent limits and so require modification to comply with regulations.

“The new FBA™ technology is capable of treating many of these higher strength pollutants and solves the problem of upgrading old systems to comply with new regulations,” says Tori Sellers.

“All businesses whose activity directly or indirectly affects the water environment are being affected by this directive. They apply to the collection of water on hard-standings - such as car parks and airports - which may mix with de-icer or fuel spillages to create contaminated surface water run-off. By exploring their wastewater management from a sustainability perspective, many businesses will find side-effect operational and financial efficiencies.

“Water companies have to invest heavily to comply with the requirements of the Water Framework Directive. These improvements mainly focus on building and improving treatment works.

“Another incentive for considering FBA™ systems is their low running costs,” says Tori Sellers. “In an economic climate where energy costs are increasing and many companies are struggling to drive costs down, FBA™ can save companies significant sums of money. When compared with alternative wastewater treatment systems, reed beds offer much lower energy costs and require much less maintenance.

“Where climate change is an increasing threat and competition even hotter, every business is considering ways to carve competitive edge by demonstrating their corporate responsibility credentials. Reed beds offer a commercially-astute, wastewater, treatment solution and are undoubtedly far more attractive than conventional systems into the bargain!”