

Leisure

ARD

natural waste water treatment

ARM Group Ltd

natural wastewater treatment



Whether you're thinking about a new reed bed system, or you just want some timely expert advice about effective operation, we can help.



Harnessing natural technology

Ever since natural waste water treatment systems came of age in the 1980s, ARM Ltd has led the way in reed bed and constructed wetland technology.

Working with the UK water companies, councils, contractors, industrial clients and research institutes, we have designed, built and maintained many hundreds of reed bed systems. These range in size from 10m² up to 20,000m², and we have consulted on reed beds of many hundreds of hectares.

Harnessing natural processes, we engineer them to deliver all the advantages of cost-effective, versatile and sustainable wastewater treatment – and we guarantee the performance of every system we design and install.

As the largest dedicated UK company by far in this specialised field, with a reputation dating back to 1947, ARM brings you unique expertise and experience. We can support you at every stage of the process – from initial planning and design through construction and commissioning to ongoing maintenance – ensuring the optimum performance of your reed bed system.

We continue to pioneer new and innovative ideas. Recent developments include an aggregate recycling system to reduce landfill costs and material usage, and a plough to retrofit FBA™ airlines into existing reed beds.

Why use reed beds?

The Chinese used wetlands more than two thousand years ago for their impressive effluent and water treatment capabilities.

Reed beds provide an ideal environment for a wide range of treatment processes. The combination of micro-organisms, plant roots, rhizomes and substrate matrix remove contaminants in a variety of natural ways.

They treat waste water as it flows through the system just like the process in conventional sewage treatment, but without using energy-intensive machinery.

With low maintenance requirements,

low or zero power consumption and a long, productive lifespan, reed bed systems are both proven and sustainable, enhancing any landscape. Their removal mechanisms include settlement, filtration, biological and chemical action, containment and plant uptake. They can reduce levels of soluble organic matter, suspended solids, ammonia, pathogens, hydrocarbons, and metals.

The various types of reed bed can be used in different configurations to treat a variety of pollutants from industrial or municipal sources.

natural wastewater treatment



Performance guaranteed

Our reed beds are used at all stages of the sewage treatment process providing primary, secondary and tertiary treatment as well as sludge dewatering.

They can also extend the life of older treatment works by providing a tertiary polish to effluent, bringing it within regulator consent, and saving capital expenditure.

They are increasingly used for tackling industrial effluent. Uses range from treating fire-fighting foam and metal removal from minewater drainage, to reducing ammonia levels in leachate and removing hydrocarbons from groundwater.

Other applications include treatments connected with:

- agriculture
- pharmaceutical
- food processing
- chemicals
- refinery waste
- distillery wastewater
- airport run off
- Sustainable Urban Drainage Systems (SUDS)

They can also be used to create wetland habitats – enhancing bio-diversity.

Whatever the application, we provide contractual guarantees of effectiveness, performance and quality – so you can be sure you're going to get the results you're looking for.



Our comprehensive range of services includes:

Consultancy: feasibility studies, process design, site surveys, landscape design, and advice on managing future changes

Project management: our experienced managers will look after your entire project from conception through to completion.

Design and build: our turnkey service delivers systems on time and within budget, including liaising with regulators and enforcement authorities on your behalf.

Design and supply of materials and equipment: a service we provide on request, for example to framework contractors.

Construction service: using our design or your own, we make it easy for contractors and save our clients significant amounts of money through design reviews based on experience – without compromising quality or performance.

Field services for system maintenance: we extend the life of your system, bring you peace of mind and help you get the best possible results.

Asset assessment: we evaluate process efficiency, check your system is operating at top performance, and make recommendations.

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ARM Group Ltd

About Us



ARM Group Ltd, a Staffordshire based privately owned company, is the leading designer and constructor of natural waste water treatment systems and associated technologies for the industrial and municipal waste water treatment market in the UK. The Company is noted for its invention and subsequent commercial development of equipment and processes within its chosen markets.

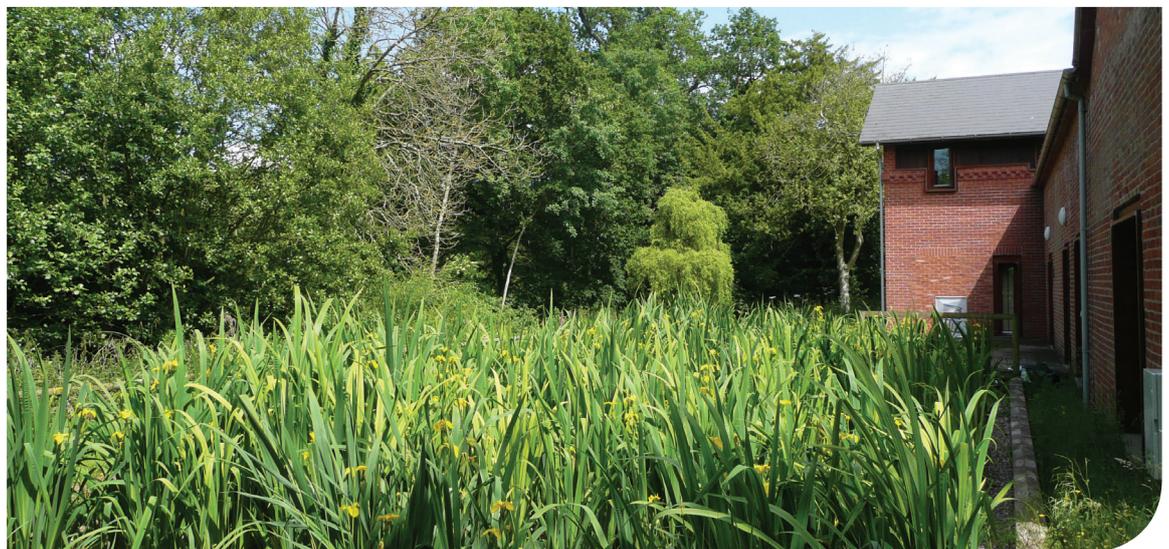
ARM Group Ltd has been trading since 1947 and was originally involved in development, design, manufacture, and construction within Agricultural Engineering. However, in the late 1980s ARM Group Ltd redefined its objectives and moved its customer and product bases into the global market of wastewater treatment specialising in the use of reed bed/wetland systems.

Today the Company operates out of offices in Rugeley, Staffordshire employing 21 people and using Associates and sub-contractors as required.



ARM Group Ltd is broadly divided into seven operating functions these can provide client support either individually, as a team, incorporating the requisite elements, or as a whole providing continuity of support for turnkey solutions from project conception through design construction, commissioning and maintenance, depending on the specific needs of the client. The functions are:

- Sales
- Design
- Project management
- Construction
- Research and Development
- Refurbishment and Maintenance
- Administration





Experience

For the past 30 years ARM Group Ltd have specialised in reed bed and wetland systems having designed and installed over 700 beds during this period. This provides us with unique and extensive experience of their application, design and construction across the wastewater treatment spectrum. Our experience and knowledge has been accumulated through:

- Design and construction of reed bed systems
- Value engineering optimisation
- Application experience
- Working with academic institutions.
- The international constructed wetlands conference circuit
- Presenting papers
- Personal contact with leading researchers
- Working relationships with leading specialist in specific reed bed applications
- Founder member of the Constructed Wetland Association (CWA)
- Founder member of Global Wetland Technology (GWT)
- Over 1000 reed bed surveys

We have designed and constructed reed beds that provide treatment for:

- Mine water
- BOD and COD reduction
- Methanol removal
- Copper removal
- Pathogens
- Landfill leachate
- Hydrocarbons
- Septic tank waste
- Ammonia
- Surface water run off
- Solids
- Sludge dewatering
- Storm water
- Metals
- Glycol



Llanfair PG, Wales

Passive vertical downflow: Secondary sewage



Project

Llanfair PG, Cheshire County Council

Location

The Conway Centre

Project Type

Design and construct

Wastewater Type

Secondary sewage

Completion Date

2009

Treatment System

Passive vertical flow reed bed

Needs

The Conway Centre in Llanfair PG is owned and run by Cheshire County Council as a residential and day arts and outdoor education facility. It is set in idyllic National Trust parkland on the Island of Anglesey in North Wales. The centre is primarily for students and pupils from schools and colleges in Cheshire though other organisations use the facility. For many years the wastewater generated on site was discharged post settlement into the Menai Straits adjacent to the centre relying on dilution as a means of effluent management. Conscious of their environmental responsibilities and that this was an educational establishment Cheshire County Council felt that a more appropriate method of effluent management should be used on the site and were keen to select as sustainable solution as possible. Their environmental consultants, Peak Associates requested ARM Ltd to design and install a suitable reed bed treatment solution.

More than 21,000 children and adults attend the centre each year and there are 420 beds on site making it one of the largest residential arts and educational centres in the UK.

FLOW AND LOADS		INFLUENT AVERAGE	DISCHARGE CONSENT
Flow	(m ³ /d)	55	–
BOD	(mg/l)	400	40
Suspended Solids	(mg/l)	300	60

The measured loads and consents are outlined in the table above.



Llanfair PG, Wales



Solution

The treatment solution had to be positioned near to the rear of the main accommodation building in line with the existing sewerage infrastructure where there was limited available space. The National Trust also specified that a specific distance be maintained from mature trees in this area. Trial pits were dug to establish the position of the existing effluent pipes. These were taken into consideration in the new treatment reed bed design and subsequently required minimal alteration. Because there was little available land a passive vertical flow reed bed was selected as the most appropriate solution. This allowed us to adjust the dimensions of the bed to fit the available space. ARM Ltd installed a 60 m³ two

stage settlement tank, specified by others, followed by a bed of 440 m².



Benefits

The reed bed treatment installation provided Cheshire County Council with an improved, robust and sustainable treatment solution for the Conway Centre. The reed bed also became a feature for the centre being used as an example of sustainable technology development and application for children and others attending courses.

Wolseley Bridge

Aerated saturated vertical flow reed bed



Project

Wolseley Bridge,
Wildlife Trust, Visitor Centre

Location

Wolseley Bridge, Staffordshire

Project type

Refurbishment

Wastewater type

Primary treated,
municipal waste water

Completion date

June 2012

Treatment

Aerated saturated vertical
downflow

Need

The Wildlife Trust Visitor Centre at Wolseley Bridge is the headquarters of the Staffordshire Wildlife Trust. It is set in 26 acres of landscaped gardens which are managed for wildlife and provide a visitor attraction for thousands of visitors each year. As well as toilet facilities there is a small sandwich cafe which generates wastewater for treatment. The centre has seen increasing numbers of visitors over the years and has added conference facilities. This has resulted in the need for the wastewater treatment system to evolve with demand to achieve adequate treatment for discharge into Stafford Brook which lies alongside the Visitor Centre.

Staffordshire Wildlife trust established the centre in 2002 and initially a horizontal flow reed bed was used to treat discharge from a septic tank installed on site. In 2005 the bed was converted to vertical downflow to treat the higher loads associated with increased visitor numbers and the introduction of an ammonia consent. For the same reason the reed bed was converted to an aerated vertical downflow system using Forced Bed Aeration™ (FBA™) technology in 2012. Details of the loads passing forward to the beds are given below.

	AVERAGE FLOW RATE (M ³ /D)	BOD (MG/L)	BOD (KG/D)	AMMONIA (MG/L)	AMMONIA (KG/D)	SUSPENDED SOLIDS (MG/L)
Load	0.54 – 7	426	3	63	3.7	511
Consent	–	20	–	12	–	30

The varying flow rates, and consequently loads passing forwards, are characteristic of an event driven system common with visitor attractions which requires a solution which can offer adaption to changing treatment requirements.





Solution

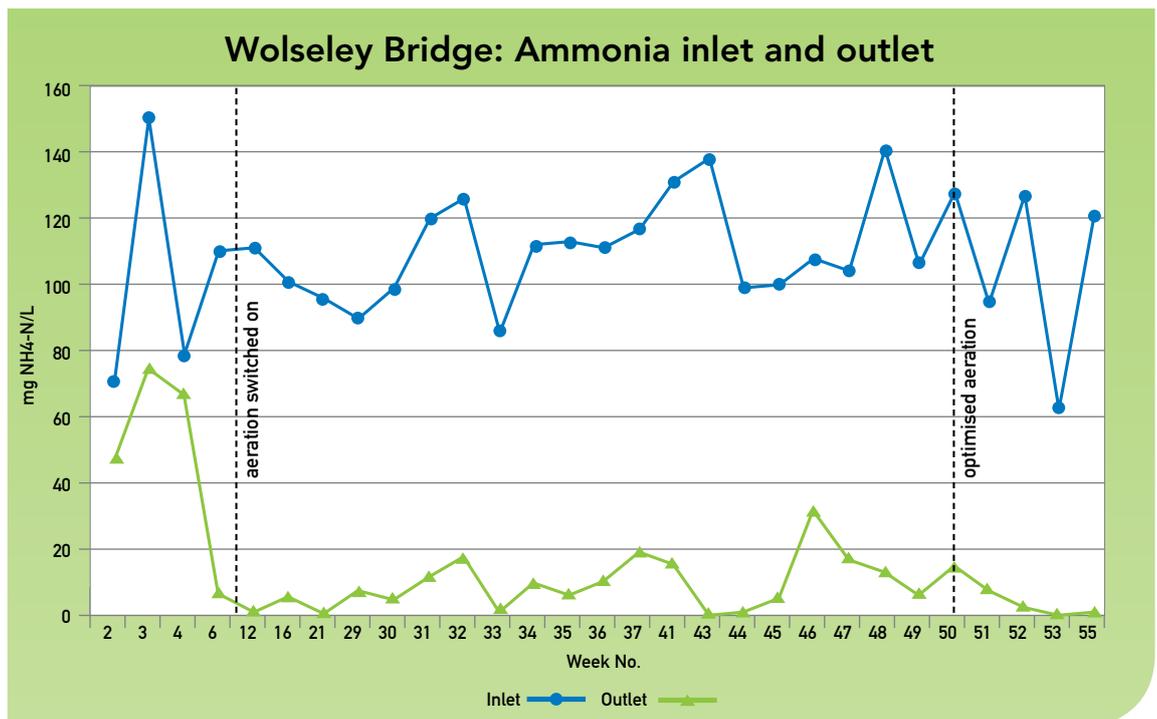
In 2011 as a result of fluctuating and increasing loads from the Visitor centre the bed was converted to a FBA™ system. Yellow flag irises were planted to make the bed more of a feature as it is positioned directly adjacent to the Visitor Centre. Through its development the bed has not required enlargement maintaining an area of 77m². The system provides 3-37 days retention depending on loads and uses a 1.6 kW blower. The blower was initially set to run for 10 hrs per day.



Benefits

The graph below indicates the benefit of the last conversion to FBA™ technology indicating an immediate improvement in ammonia reduction from 40% to 95%. The application of air can be controlled which suits the seasonal variation in load associated with visitor numbers. The increase in variability seen in the graph caused by upstream loading changes was quickly corrected, and the potential for recurrence eliminated, through increasing the aeration to 14 hours per day.

The aerated reed bed system at Wolseley Bridge provides the increased level of treatment required by the site to discharge into the Staffordshire Brook within consent. It also has the flexibility to adapt to varying loads seen throughout the year. The use of Flag Irises as the primary plant stock provides an aesthetically attractive water treatment solution position directly adjacent to the visitor centre.



National Botanic Garden of Wales

Saturated vertical flow: Secondary sewage



Project

National Botanic Garden of
Wales, Camarthanshire

Location

Llanarthne, Camarthenshire

Project type

Upgrade existing works

Wastewater type

Sewage

Completion date

August 2010

Treatment

Saturated vertical flow system
with FBA™

Need

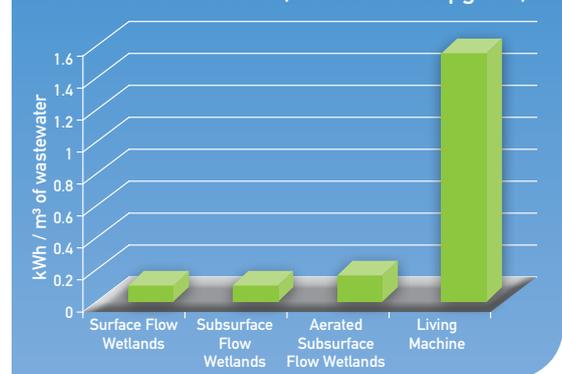
The National Botanic Garden of Wales (NBGOW) is a Millennium Commission Capital Project situated in the grounds of an old estate. In 1998 a wastewater treatment system was installed comprising a septic tank, aeration tanks, a Living Machine® package treatment system and a reed bed. This aging system had a high energy consumption and the design was insufficient to cope with increased visitor numbers. The existing system required upgrading to treat the peak flows of 40m³ per day, 2000 visitors and 90 members of staff per day whilst reducing energy costs.

Solution

NBGOW design philosophy is that all wastes generated on site should be treated on site, and that the systems need to be designed to cope with peak loads associated with holiday seasons. ARM were commissioned to provide design optimisation and upgrade the existing system.

The Living Machine® and aeration tanks were decommissioned. The existing 128m² vertical flow reed bed was refurbished and retrofitted with Forced Bed Aeration™ (FBA) technology. The reed bed now receives flows directly from the septic tank, and will reduce BOD, Suspended Solid concentrations. The additional aeration in the system increases the oxygen availability to provide conditions suitable for nitrification which will remove ammonia.

Comparative Power Consumption of Living Machine and Aerated Reed Bed (ARM Solution Upgrade)



Benefits

The upgraded reed bed system with FBA™ has a greater treatment capability and has smaller foot print than the previous system and saves around £7,000 in energy and maintenance costs per year.



Torver

Aerated saturated vertical flow reed bed



Project

Raymond Priestley
Outdoor Activity Centre

Location

Torver, Coniston Water, Cumbria

Project type

New build

Wastewater type

Primary treated,
domestic waste water

Completion date

December 2012

Treatment

Aerated saturated vertical
downflow

Need

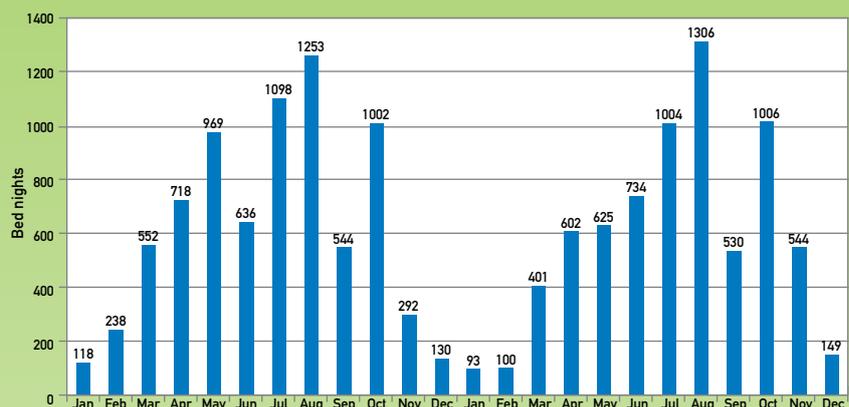
The Raymond Priestley Centre is an outdoor activity centre owned and operated by the University of Birmingham situated on the shores of Coniston Water in the Lake District. National Park The centre provides residential courses throughout the year for Birmingham University staff and students as well as members of other academic institutions, sports clubs and corporate clients.



The relatively remote positioning of the site necessitates an offline, bespoke water management system for the treatment of sewage and grey water generated on site. Once treated, this water has to be discharged into the local environment. The existing wastewater treatment system was established in the early 1970's and comprised a septic tank and a soakaway system. The centre is popular and increasing numbers of people are attending courses each year, thus there was concern about the existing water treatment systems capacity to maintain adequate treatment.

The graph below indicates the seasonal variation in residents staying at the centre giving rise to variable wastewater loads passing forward for treatment. This requires a flexible and adaptable treatment solution.

Raymond Priestley Centre monthly bed nights 2008 – 2010



Based on an agreed maximum residential capacity the following table indicates the

	FLOW (M3/DAY)	BOD LOAD (G/DAY AND MG/L)		AMMONIA LOAD (G/DAY AND MG/L)	
Average	4.97	2,068 g	416 mg/l	220g	44 mg/l
Peak	9.56	3,960 g	414 mg/l	421g	44 mg/l

design loads for treatment. The proximity of Coniston Water (20 metres) required a robust reliable treatment solution.



Solution

ARM Ltd's solution was to make use of the existing treatment assets and enhance them with a Forced Bed Aerated™ vertical downflow reed bed situated between the septic tank and soakaway. Following liaison with the Environment Agency some refurbishment of the soakaway was undertaken and a 70m² aerated reed bed was installed to aesthetically blend into the site without affecting site activities. The aeration provides high level and consistent performance with an element of control of treatment capacity and power consumption.

Benefits

The aerated reed bed system at the Raymond Priestley Centre provides the increased level of treatment capacity required by the site as well as the flexibility and consistency to adapt to the varying loads seen throughout the year. The use of reed bed technology minimises the requirement for operational maintenance by site staff and is apposite for an Area of Outstanding Natural Beauty within the National Park.





Forced Bed Aeration (FBA)

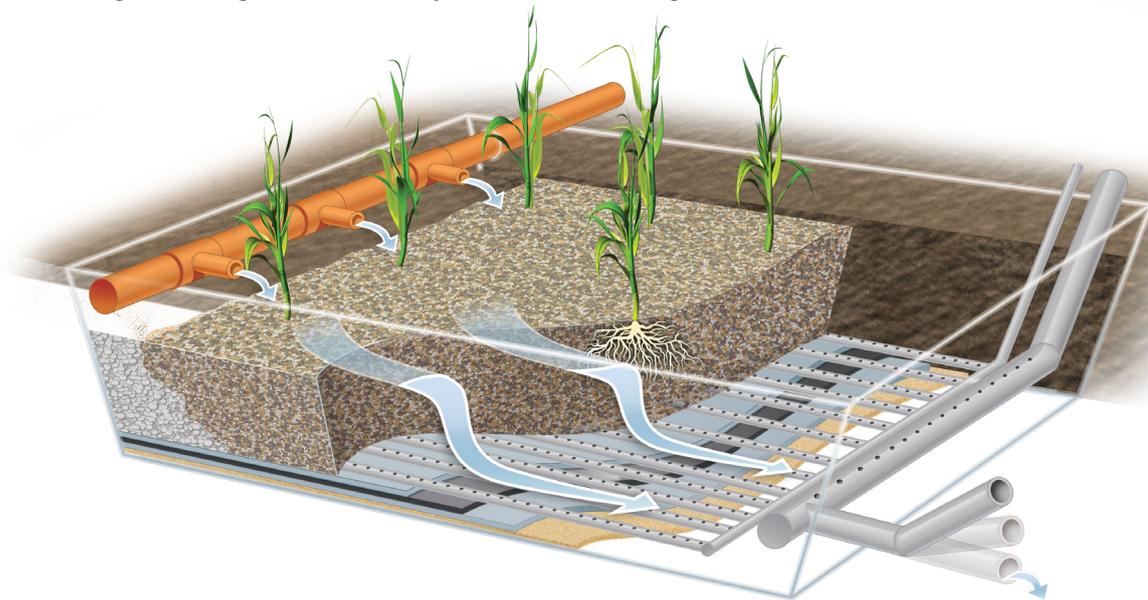
Forced Bed Aeration™ compliments and enhances existing reed bed technology, increasing treatment capacity by up to 15 times.



Forced Bed Aeration™ (FBA™) is a new wastewater treatment technology which enhances constructed wetland treatment performance. Significantly higher contaminant removal rates are attained along with an increased consistency of performance. Developed in the USA, by our partners Naturally Wallace, FBA™ can be used in both horizontal and vertical flow constructed wetland systems. Blowing air through the wetland system

makes the system oxygen unlimited increasing the treatment capacity by up to 15 times. This new technology can treat wastewaters high in BOD, SS, NH₄-N and other organic contaminants.

Forced Bed Aeration™ reed beds can reach performance levels which have been unobtainable in standard reed bed systems with less performance variability. Aeration of horizontal and vertical flow reed beds has multiple advantages.



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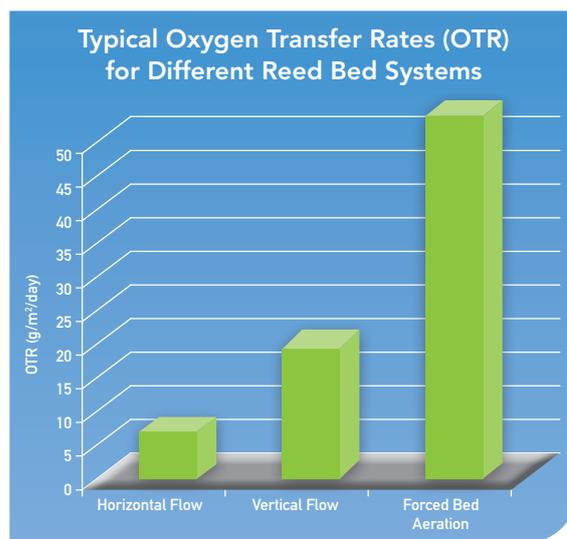


- FBA™ can completely nitrify wastewater
- FBA™ systems can be deeper than conventional reed beds therefore taking up 50% less space than passive systems.
- Plants thrive in FBA™ systems because the introduced oxygen prevents the formation of toxic products that can stunt plant growth in strongly anaerobic, passive system
- FBA™ reed beds can be divided into aerobic and anoxic zones to both nitrify and denitrify.
- FBA™ reed beds are ideal for treating fluctuating loads such as CSO's and locations with variable occupancy.
- Initial studies indicate FBA™ systems have reduced clogging rates extending the operational life of a treatment system.

technology prevents root rhizomes penetrating the emission points.

Adapting FBA™

FBA™ can be retrofitted to existing reed bed systems, especially those which are overloaded. This prolongs the life of the reed bed and enhance effluent treatment.

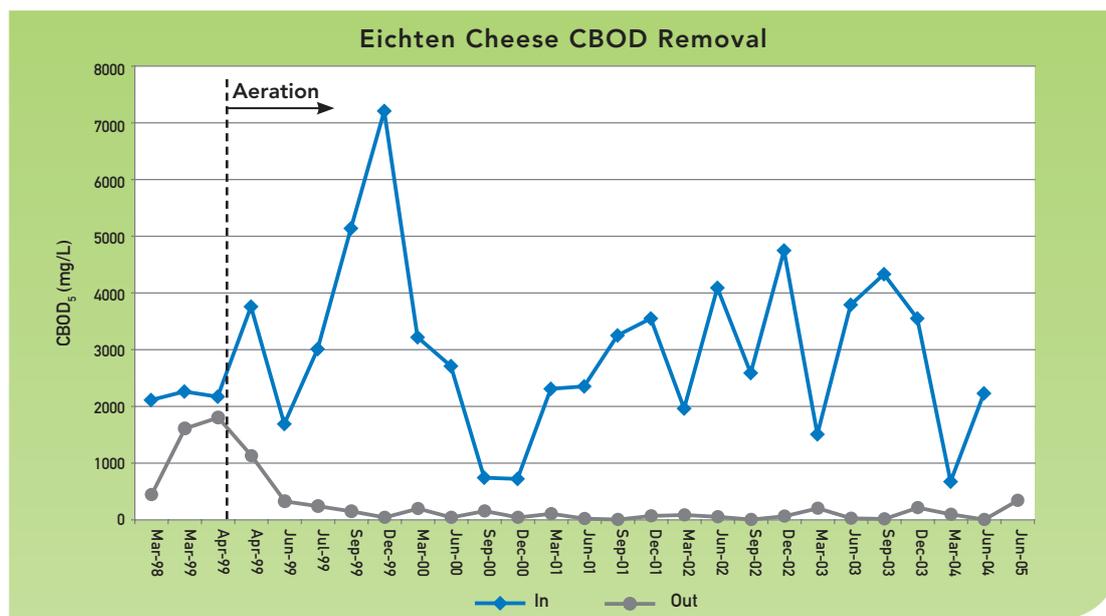


Pipelines

FBA™ has a unique network of pipelines which provides a constant flow of oxygen into the reed bed. Patented rootguard

FBA™:

- Improves treatment capability.
- Reduces clogging rates.
- Requires minimum power input.



Graph indicating the treatment performance of an FBA™ wetland system treating cheese production effluent

natural waste water treatment

Asset Assessment & Support Package

natural wastewater treatment

Knowledge and proactive management of assets is a key area where water companies can cut operational and capital expenditure. The optimisation and enhancement of remote reed bed treatment systems can secure performance for many years without the need for full site refurbishment and the associated costs.



In the September 2012 issue of *Water & Wastewater Treatment* it was reported by the editor that knowledge by the majority of water companies of the condition of their assets is poor. According to the report from the consultancy company E C Harris, some 90% of maintenance in the UK water industry is reactive. Yet it is well known that proactive maintenance will cut costs by upwards of 50%.

Although this is not the case with all water companies we thought it would be an ideal opportunity to offer a simple solution. ARM Ltd have been designing, constructing, refurbishing and retrofitting reed beds for many of the UK's water companies

for decades. It is for this reason we feel best placed to offer you our new Asset Assessment and Support Package (**AASP**).

Reed beds are generally tucked away in Sewage Treatment Works and because they provide treatment with minimal maintenance requirements often get overlooked until the works are close to breaching consent. Our Asset Assessment and Support Package will highlight the condition of the system and give an indication of when refurbishment may be required. This allows expenditure to be planned and therefore controlled and ensures the works performs to its full capability.



Our Asset Assessment and Support Package works in two ways:

1. Asset Assessment

Visual Appraisal

- Condition of the reeds
- Extent of sludge build up on and in the gravel matrix
- Condition of the flow path
- Site layout and accessibility
- Photographic evidence

Fitness for Purpose

- Review design basis, 'as built' drawings and O & M Manual
- Review current and future loads and recent performance data

Monitoring program

- Sampling and monitoring program to include influent flows/loads and discharge levels to characterise performance

Reporting

- Verbal and written report of the assessment complete with conclusions, recommendations and indicative prices of any required remedial work

2. Support Service

- Asset longevity prediction
- Sampling and monitoring to establish performance
- Refurbish to 'as built'
- Re-engineering to improve performance
- Maintenance
- System operation
- Retrofit with latest technologies to enhance capability

We would be happy discuss any aspects of this service with you and can be contacted at info@armgrouppltd.co.uk or telephone on 01889 583811.