

Aquabio Customers:

Municipal:

Thames Water
Southern Water
United Utilities
Scottish Water
Yorkshire Water
Northumbrian Water
Wessex Water
Anglian Water
States of Guernsey Water Board
Essex & Suffolk Water

Industrial:

Unilever
Bakkavör
Kanes Foods
RHM/Premier Foods
UNIQ
Simpsons Malt
Muntons Malt
Greenery Biofuels
Universal Beverages (UBL)
Diageo
Ineos
Simon Storage
DEFRA
Carillion
Solutia
G's Beetroot
BOC Linde
Pittards Tanneries
NCT & Scottish Leather
St Regis Paper
General Mills (Cheerios)
Northern Foods
BLC Leather Technology
AGBAR Barcelona
SITA Swire
Dawn Foods
Bulmers Ireland
Synthomer
Veolia
SI Group

Market Sectors:

Municipal
Food & Beverage
Breweries
Distilleries
Pulp & Paper
Chemical
Pharmaceutical
Landfill Leachate
Tanneries and Abattoirs



**Leaders in Energy Efficient Wastewater Treatment
and Water Reuse**

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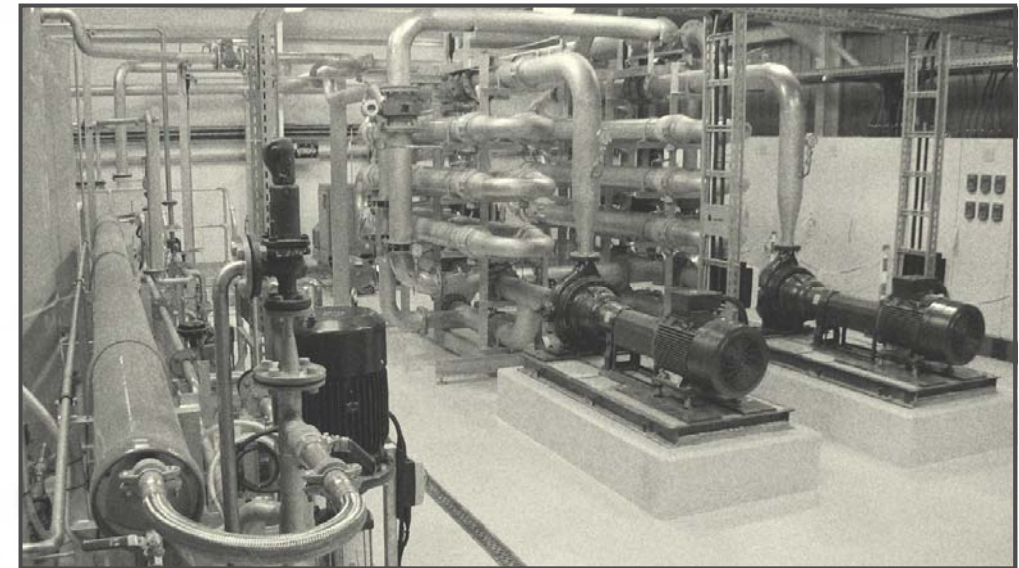
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Membrane Bioreactors



For Cost Effective & Energy Efficient Wastewater Treatment:

- AMBR™ - High Flux Crossflow
- AMBR LE™ - Low Energy Crossflow with Backflush
- BIOVERT® - Low Energy Air Assisted Crossflow

Aquabio Membrane Bioreactors

Aquabio's crossflow membrane bioreactors (MBRs), using tubular ultrafiltration membranes, are the most compact and cost effective MBR systems available.

By developing three types of crossflow based technology Aquabio can offer clients the most cost effective alternative for their particular circumstances. All Aquabio MBR plants have 'true' ultrafiltration membranes mounted *outside of the bioreactor in dry conditions* which means hygienic operation, ease of maintenance and *no moving parts immersed in the biomass*:-

AMBR™ - Utilises high crossflow to achieve high flux rates. The bioreactor can be operated at high biomass suspended solids concentration (MLSS). The technology is aimed at lower flow and higher strength industrial wastewaters. Plants are extremely compact, with very low membrane area and low membrane replacement costs. The membrane banks are operated automatically based on level in the bioreactor and hence are utilised, as required, to match the inlet flow. When not required individual membrane banks are automatically shutdown, auto-flushed to remove biomass and await re-start thus saving energy when the plant is not running at full design, or when membrane flux is higher than design. AMBR™ plants are modular, can be containerised and are relatively low in capital investment cost.

AMBR LE™ - Utilises intermittent backflushing for the control of membrane fouling and hence allows a reduction in crossflow velocity and a significant saving in energy. Medium to high MLSS concentrations are accommodated and AMBR LE™ is aimed at medium to high flow and low to high strength industrial and municipal wastewaters. With variable speed recirculation pumps the system allows for variable flux rates which is used to optimise energy use relative to the plant load. Plants remain very compact, with low membrane area and moderate membrane replacement costs. Plants also operate on a direct link to level in the bioreactor, automatically adjusting membrane permeate production (and energy use) to suit the inlet flow conditions. AMBR LE™ is particularly suited to applications with inconsistent or variable wastewater flows, high peak or seasonal loads, or when electricity costs are moderate to high.

BIOVERT® - Incorporates vertically mounted modules and uses air injection to further reduce energy consumption. This process allows for medium MLSS concentrations and is aimed at higher flows and low to medium strength industrial and municipal wastewater. Plants are compact, with vertically mounted membrane modules and greater membrane area. Plants operate on a more constant level in the bioreactor, with controlled air injection at either the top, or the bottom, of the membrane tubes. Air scour and turbulence reduces surface fouling and energy use is very low. BIOVERT® plants are particularly suited to applications with consistent wastewater flows and when electricity costs are high.

Simplicity of Operation - "Through Complexity to Simplicity"

Continuous development of automation and control systems over the past ten years has led to simple operation for our clients using Aquabio's proprietary software. Real time monitoring of our plants is a standard feature using internet links. All plants have automatic operation including, flushing, backflushing, cleaning, start up and shutdown on demand.

MBR Type	Normal Operating MLSS range (gTSS/l)	Sustainable Normalised flux LMH	Energy use on biomass separation kWh/m ³ permeate produced	Configuration/ Maintenance	Energy Management
AMBR™	10 to 20 (Air) 15 to 35 (Pure oxygen 'enhanced')	80 to 250	1.8 to 3.5	'Dry', out of tank. Low level, horizontally mounted membranes	Yes. Banks are automatically flushed & shutdown on low/no flow
AMBR LE™	10 to 20	40 to 120	0.4 to 1.4	'Dry', out of tank. Low level, horizontally mounted membranes	Yes. Permeate flow automatically regulated & banks can still be automatically shutdown on v. low/no flow
BIOVERT®	8 to 15	30 to 60	0.2 to 0.5	'Dry', out of tank. Vertically mounted membranes	Yes. Banks are automatically flushed & shutdown on low/no flow
Submerged HF/FlatSheet	6 to 12	8 to 25	0.6 to 2	Submerged in biomass & vertically mounted with coarse air scouring from below	No. Membranes submerged in biomass and must be regularly 'scoured'. Energy >2kWh/m ³ during v. low/no flow.

Advantages

- High flux and MLSS = reduced footprint
- CAPEX to OPEX balance is optimised
- Lower cost of membrane replacement
- 'True' separation of biological aeration and membrane separation functions
- Flexible operation & energy 'management'
- Fully automated
- Can be easily retrofitted to existing systems
- Dry and external installation, doesn't take up aeration capacity
- Can be supplied as modular/containerised systems
- Can be used with supplementary Pure O₂
- Choice of systems means a bespoke plant tailored for each Clients needs and budget

MBR and NF/RO Pilot Plants:

AMBR™ – 20' Container
 AMBR™, AMBR LE™ & BIOVERT® 30' Container
 NF/RO – Skid mounted unit suitable for potable/demineralised water reuse trials

Case Study - Food Wastewater to potable reuse

Kanes Foods (2009):

- Varied food processing wastewater
- Screening and physico-chemical pretreatment
- AMBR LE™ low energy crossflow secondary MBR treatment (12g/l MLSS)
- Variable flux rates, 40 to 100 litres/m²/hr (LMH) to suit inlet conditions
- Energy for biomass separation : 0.42kW/m³ permeate produced
- Energy 'management' with permeate automatically regulated. Banks shutdown and autoflushed and very low/no low
- Reverse Osmosis post treatment for water reuse
- RO permeate at potable quality and blended with incoming towns water for reuse in the factory



ECA – Enhanced Capital Allowance Tax Incentive Scheme (UK Govt/DEFRA): 100% of Capital expenditure is fully allowable in Year following start-up of 'eligible' plant reusing >40% of factory water - Includes all capital on single project to achieve >40% reuse i.e. civil works, pre-treatment, biological/secondary and tertiary plant.

Applications

- Secondary wastewater treatment to sewer or surface water
- Wastewater Reuse:
 - Non potable for washing, irrigation etc.
 - Potable/demineralised - with post treatment using nanofiltration or reverse osmosis and optional UV disinfection or chlorine dioxide dosing.
- Nutrient removal, nitrification and denitrification

