

## Packaged Biological Waste Water Treatment Plant using Fixed Bed with Attached Growth Biomass



Fixed Bed Bioreactor (FBBR) waste water treatment plant, Thames Water UK.

Using a fixed bed biozone with a pvc support matrix of 150 m<sup>2</sup>/m<sup>3</sup> specific volume to provide a stable platform for an attached biomass concentration of up to 9000 mg/l.

The high biomass concentration is largely fixed to the support matrix ensuring the biomass in solution is of low concentration and will not overload the downstream settlement clarifier.

The FBBR process is highly efficient in terms of biological oxidation of organic matter as well as energy consumption.

The process is extremely biologically stable and can accept long periods of under load, shock loads and periodic overloads.

Typical example of a 'containerised' and standardised FBBR plant. Fully packaged including inlet screen and grit removal, biozone, clarification and tertiary treatment using pressure sand filtration.

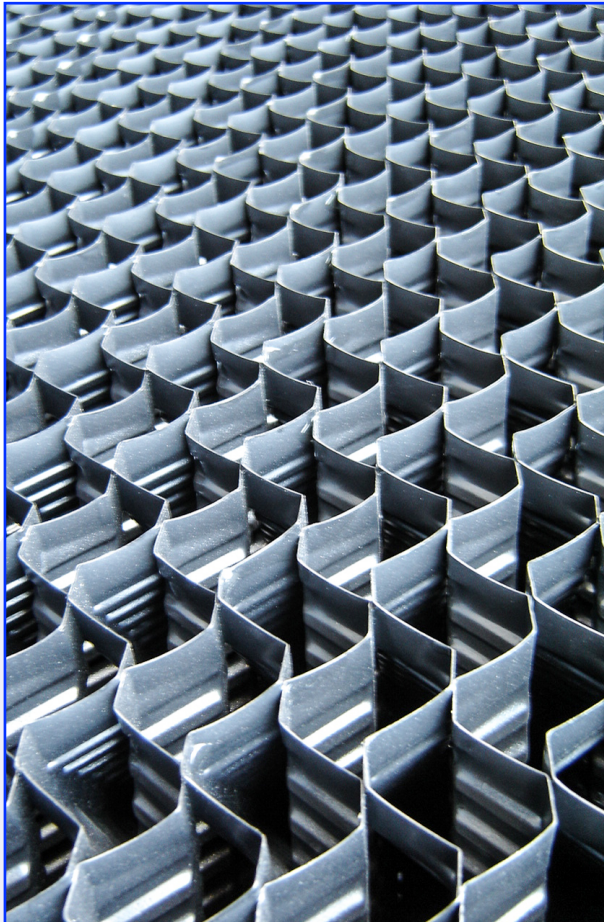
This type of FBBR plant is standardised to populations of 100, 250, 500 and 1000 persons.

The plant will deliver a treated effluent of 10mg/l Suspended Solids and 10 mg/l BOD. The effluent is fully nitrified.

This FBBR plant in all of its sizes is available as a plug and play package, manufactured in Ireland and available for delivery globally.



## The FBBR Plant Biozone



The FBBR plant is a fixed-bed bioreactor using “Attached Growth” technology by means of a submerged, aerated, high surface area media.

The ‘heart’ of the system is a structured matrix of welded and rigid polypropylene media with a very high specific surface area. This allows for high concentrations of attached biomass to be maintained in the Biozone.

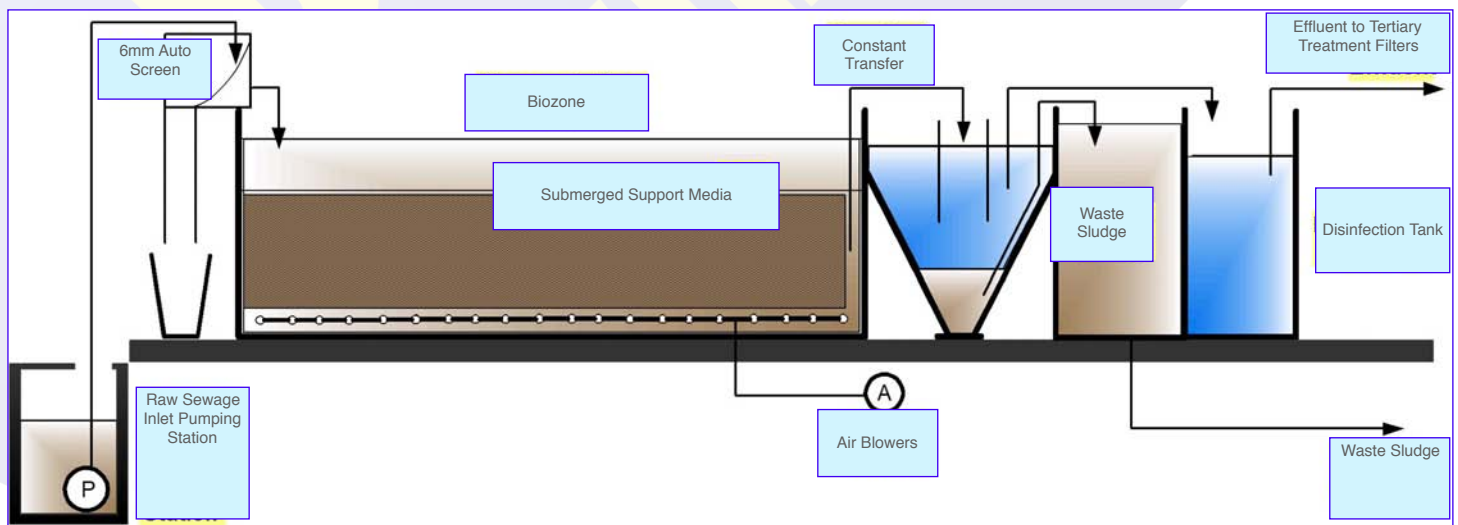
The unique flow patterns within the media ensure high rates of biological oxidation with relatively low retention time. The media ensures air bubble retention is prolonged and allows for exceptionally high oxygen transfer rates with low energy consumption.

There are few moving parts within the plant allowing for low maintenance and low operator demands.

The FBBR is well proven over decades, with reliable, robust and trouble free operation.

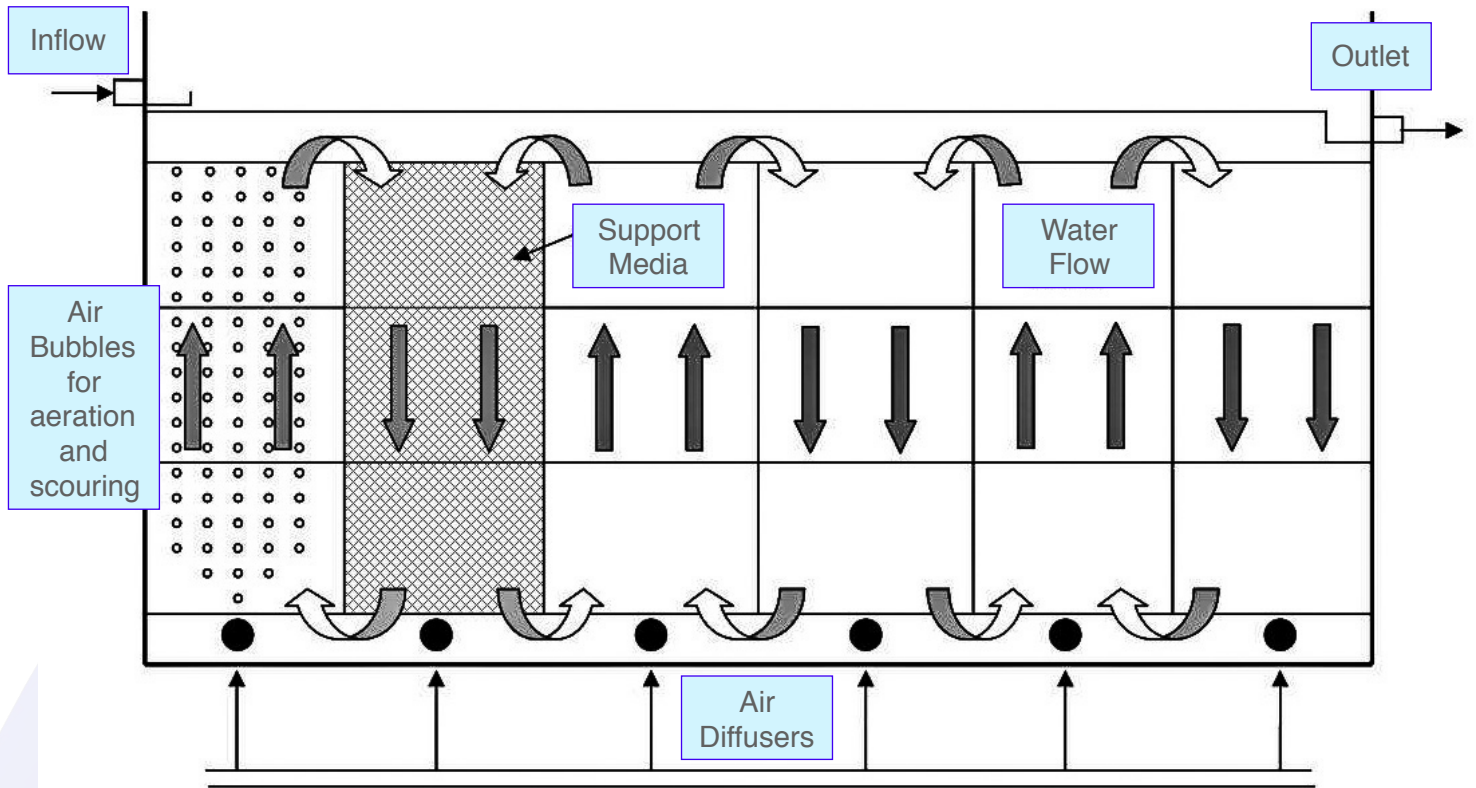
Due to the gentle but fully mixed environment within the Biozone, the biomass is allowed to grow to a long sludge age before being “sloughed” from the media. This produces excellent effluent with good nitrification, partial de-nitrification and low levels of waste sludge production.

FBBR plants are either pre fabricated steel, package containerised or use insitu concrete tanks for larger plants. Existing treatment plants can be upgraded for capacity and effluent quality by adopting FBBR technology.



Schematic Process Flow through a FBBR Plant. There is no requirement for a return sludge flow

Section through the FBBR Biozone showing the support media and the water and air flow pattern



**Tertiary Treatment Pressure Sand Filters.**  
Auto or manual backwash.

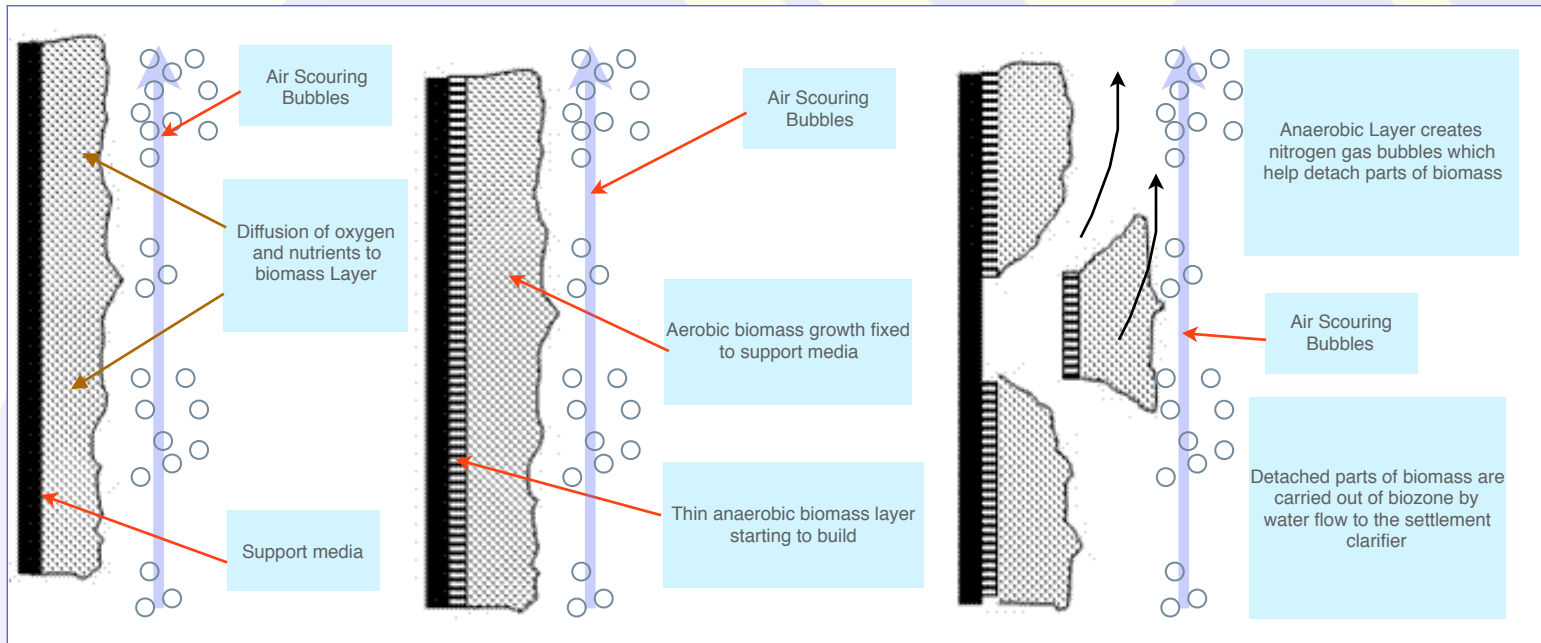


**Side Channel Air Blowers.** Efficient and quiet



**Standard switchgear control panel and motor PLC**

**The FBBR 'Sloughing' Process. Looking in detail at the biomass attached growth, its biological oxidation and its eventual detachment from the support media**



The biozone support structure - or matrix - performs the task of 'fixing' the biomass in the Biozone, is the 'fixed bed' part of the bioreactor. The support media performs a critical, multi-functional task :

1. It provides a very benign and attractive place for the biomass to grow to very high concentrations
2. It provides extremely high contact areas between the liquid and the biomass and long contact times
3. It delivers long air bubble retention times for high oxygen transfer efficiency
4. It shears the air bubbles emerging from the medium bubble air diffusers delivering oxygen transfer efficiencies close to fine bubble type for reduced power consumption
5. It allows the biomass to remain in the reactor for full nitrification and partial de-nitrification without anoxic steps or mixed liquor re-circulation

**The FBBR Fixed Bed Support Media, Biomass Concentration and Process**

The FBBR plant operates with a retention time of between 4 - 6 hours in the Biozone. This demands a very high concentration of biomass ("equivalent" MLVSS) to be embedded and fixed in the bioreactor. The biomass is delicate and must be provided with a gentle environment to thrive. The FBBR plant provides just these conditions.

The "Sloughing" diagram above shows how the biomass can grow fully to a thickness whereby an anaerobic layer is formed at the surface of the support media. The "sloughed" biomass is further assisted by the action of the aeration bubbles passing over the surface of the biomass. This "sloughed" biomass is collected in the settlement tank, where it settles very easily. Because the biomass is correctly fixed in the biozone, sludge return ( or RAS as in an activated sludge plant) pumping is not required in the FBBR plant - thus eliminating a major operator task. The FBBR plant does not suffer from filamentous bacteria.

Because the FBBR plant is an advanced version of a conventional fixed bed bioreactor, such as a trickling filter, it still utilises conventional settlement tanks for clarification. With such a high MLVSS concentration in the bioreactor, it is critical that the active biomass remains attached to the support media. The "sloughed" biomass, as described below, is carried to the settlement tanks where it is captured and disposed of to the sludge consolidation tank. The FBBR process ensures the "sloughed" biomass in suspension does not exceed the 3000 mg/l limit for good settlement. This is achieved by gentle air scouring, the naturally occurring nitrogen bubbles of the de-nitrification and running the sludge age to a point where sticky polysaccharide "glue" is removed.

As well as a delivering a fully nitrified effluent, the long sludge age in the FBBR plant and the ability to retain the biomass fixed in the bioreactor delivers partial de-nitrification as well as very low sludge production.

The FBBR plant uses Medium Bubble air diffusers. These are located at specific points below the biomass support media. The presence of the media above the air diffusers provides exceptionally good oxygen transfer efficiencies, in line with fine bubble air diffusers. The support media allows for long bubble retention times due to the "zig zag" route through the media. The high oxygen transfer efficiency reduces the size of the air blowers and with large power savings.



# Fixed Bed Bioreactor - FBBR Biological Waste Water Treatment Plant



Dynameau Lts are proud to partner with Crowley Engineering. Dynameau Ltd, a UK company provide the technical design for process technologies in water, solid waste processing, recycling and waste to energy sectors.

Crowley Environmental is division of Crowley Engineering, Cork, Ireland making OEM products for the solid waste processing, water, gasification and biogas industries. With nearly a half century of business experience of engineering designing and fabrication, Crowley Engineering are your global partner in environmental solutions in the energy, solid waste and water treatment industries.

Contact us for expert technical help.



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Oil Water Separation

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Biogas Development and Investment

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In Vessel compost systems

Biological water treatment - FBBR

Solid Waste MRF's

## Crowley Engineering

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Agricultural silos & augers

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