

ENERGY EFFICIENT AERATION USING LOW PRESSURE OXYGEN



Municipal Wastewater

Industrial Wastewater

Emergency response

Temporary and permanent installation

Additional aeration capacity

Aquaculture

Concrete Production

Waterway/River Oxygenation



Shell
Springboard
Regional Finalist

OXFINITI MOBILE WATER TREATMENT PLANT

The **OXFINITI** Mobile Super Oxygenation Water Treatment Plant uses 5 innovations to improve the operational efficiency of the activated sludge process (ASP) and concrete production. It injects 93% pure oxygen, generated within the 20 foot container, at low pressures into a wastewater stream.

The technology changes the wastewater's physical properties. A bespoke designed carburettor (based on advanced aerospace fuel systems) it creates a very efficient shear mixing environment of oxygen-wastewater. Injected oxygen is held in solution in molecular form treating wastewater more efficiently than any other process. It remains suspended in solution longer and is more easily accessible to the microbes.

It is a radical new approach to treat wastewater than any other process delivering consistently high dissolved oxygen transfer levels. It saves significant energy by up to 30%, lowers carbon emissions, reduces sludge volumes by up to 40%, lowers ammonia levels and improves plant health.

When **OXFINITI**'s oxygen rich water is used in concrete production it uses less cement (reducing carbon emissions), improves cure time and tensile strength.



FEATURES

93% Oxygen

Injected into the waste water stream at low pressures

60% Molecular Oxygen

More active in the treatment process

Novel treatment train

No drop off in oxygen efficiency or performance

Simple Installation

Easily retrofitted to existing installations - Plug & Play

No periodic maintenance

Low maintenance and operational costs

Independently tested

Used by two water utilities to improve DO levels

Safe & cost effective

No dangerous liquid oxygen or high pressures

Reduction in Health and Safety Risks

Entire process within secure container

Applications

- All biological treatment processes requiring oxygen injection
- ASP's including ditches and aeration lanes
- Activated sludge processes (ASP)
- Concrete Production
- Rivers and waterways during pollution incidents

ASP aeration issues OXFINITI solves

- Conventional ASPs frequently struggle to maintain DO target levels due to higher than normal or design loading culminating in insufficient aeration.
- At peak load times ASP's can become under aerated which often results in high ammonia levels.
- Increasing the number of aerators in existing systems will not necessarily increase aeration and the capacity to meet DO targets.

A flexible solution

The **OXFINITI** plant delivers 1000kg/day of 93% pure oxygen. Units are installed in plug and play self-contained 20 foot ISO containers. They can be:

- integrated into a SCADA system or operated independently
- controlled to deliver a base load or to deliver oxygen in response to changing dissolved oxygen demands by within the ASP.

Oxygen (93% pure) at low pressures is directly injected from an on board generator into a side stream taken from an ASP. The super-oxygenated stream is then re-introduced into the ASP downstream of the take-off point. This increases DO levels extremely quickly and to the desired levels.

Easy installation

- No interference with existing infrastructure
- Single or multiple systems
- Can supplement existing base loads



BEFORE



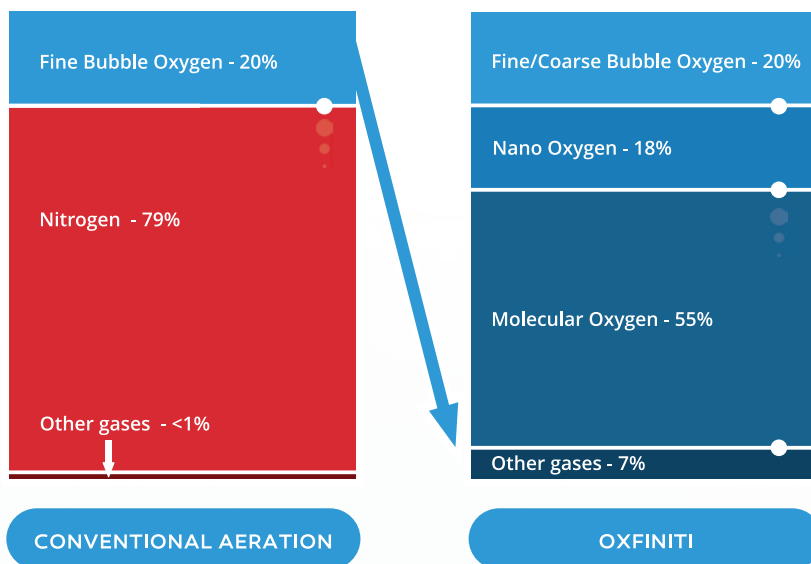
AFTER

Molecular oxygen means better DO

At least 60% of its dissolved oxygen is delivered in a 'molecular' form, rather than as 'bubbles' as in conventional aerators. This molecular oxygen enables a vastly greater and more efficient oxygen take up by the microbes improving microbe health.

Standard aeration efficiency in process Oxygen Transfer Rates (OTR) are typically measured in Clean Water at standard conditions (SOTR), and then taking the power (P) usage into consideration are expressed as 'Aeration Efficiencies' ($AE = OTR/P$).

For different conventional aerators (i.e. FBD, SA, Jet, etc.) these AE's at standard conditions (SAE) are compared on a 'like-for-like' basis by process designers in selecting aeration technology. However, in process conditions, these AE's are significantly higher by up to 75% in the Oxfiniti process when compared with fine bubble diffusers. This is due to the presence of high levels (000's mg/l) of suspended solids in fine bubble diffuser systems.



BENEFITS

30% Energy saving compared to conventional aeration

Lower sludge volumes and ammonia levels

Oxygen is more active

Persists longer in solution
- days not hours

Improves efficiency of activated sludge process 93%

93% O_2 is used rather than just 21% with conventional aerators

Basin health improvements

Flexible Super Oxygenation

Can supplement existing aeration systems or be the prime oxygenation source

More robust and reliable than existing aeration systems

Mobile system enables fast and easy installation

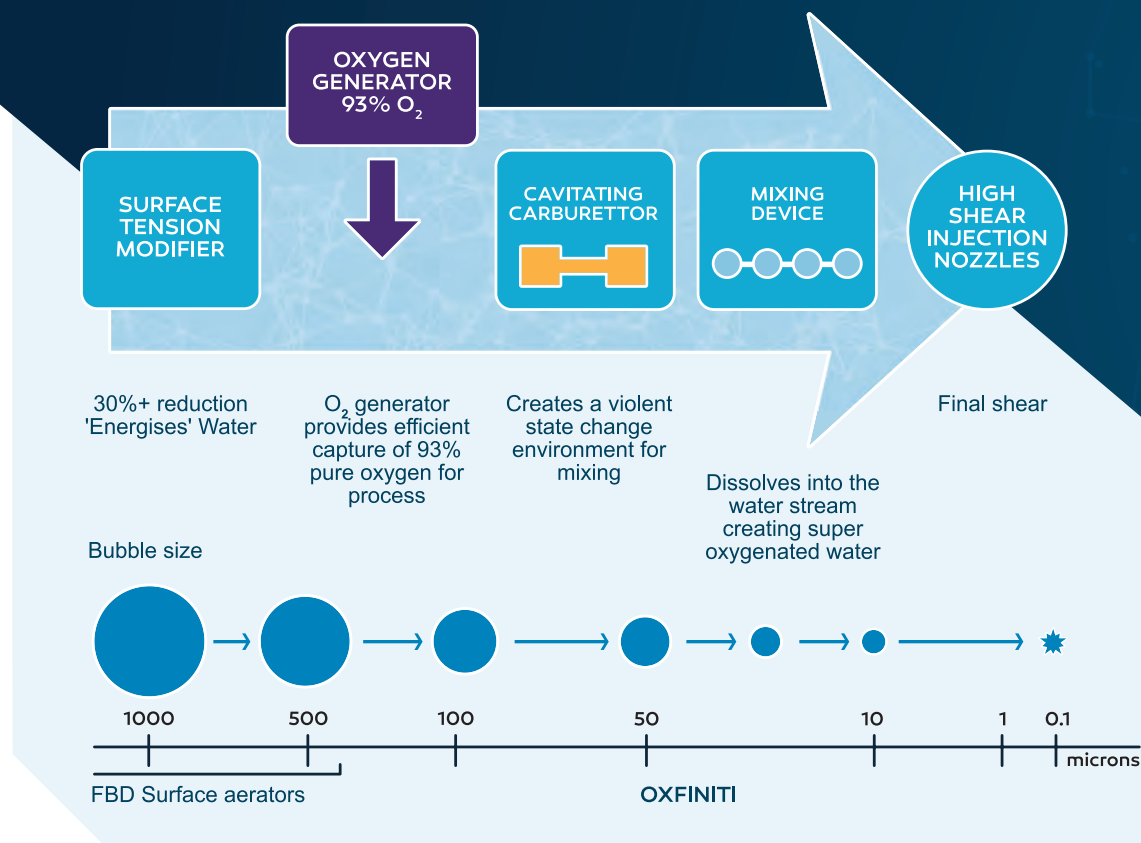
12-24 hours set up

Small footprint

Easily relocated within 24 hours

No disturbance to existing infrastructures

INNOVATION: NOVEL TREATMENT TRAIN

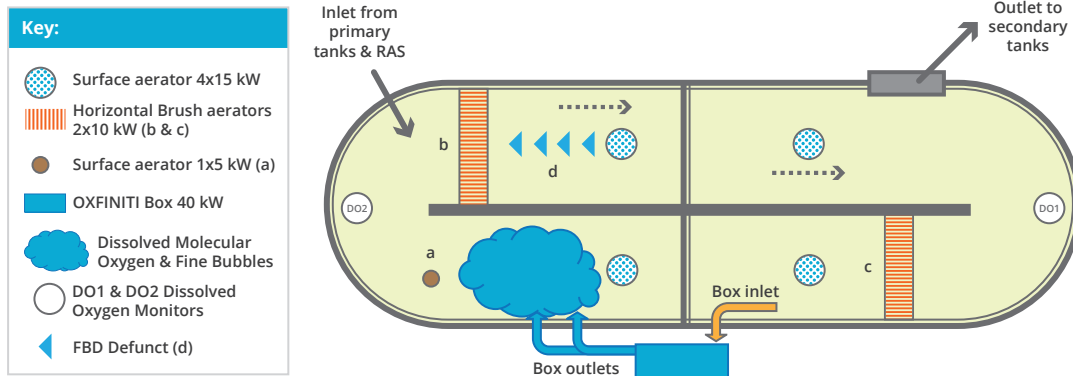


THE OXFINITI ADVANTAGE

	FBD/Surface Aeration	Oxfiniti	Oxfiniti Impact
Aeration	Air (21% O ₂)	93% pure O ₂	✓ Only 7% gas wastes energy, FBD = 79%
Power	60–70 Amps	40 Amps Equivalent	✓ Higher or improved oxygenation level, but at lower power
Aeration type	Air	Super-Oxygenation	✓ Improved use of Oxygen
Modification of Water Surface Tension	None	Reduces Surface Tension by 30%+	✓ 'Energises' the wastewater ✓ Stimulates better oxygen transfer
Bubble Size	Mm/Micro	Nano/molecular	✓ Billions of sub-micron oxygen (10 ⁻⁹) particles ✓ Increased level of dissolved oxygen ✓ Oxygen persists in solution for longer (days). Bubbles from FBD/Surface aerators rise quickly to the surface and escape ✓ Better environment for microbes
O ₂ Basin Retention time	Short	8-12 hours	✓ Works harder for longer
Maintenance	Medium	Low	✓ Replacement of low cost seals ✓ Undertaken within the box
Aeration Efficiency α factor	0.25	> 0.9	✓ Alpha factor significantly reduces with conventional aeration ✓ Oxfiniti's alpha factor remains high

Wick St Lawrence ASP Trial

This serves approximately 20,000 PE. It uses four surface, one floating and two paddle aerators.



Aeration Issues

- The activated sludge process was struggling at times owing to high loads receiving insufficient aeration.
- At frequent peak load times the ditch was under-aerated, resulting in high ammonia levels.
- The system was incapable of consistently meeting Dissolved Oxygen (DO) targets despite additional aerators being added.
- Inlet flows to the works varied fivefold impacting oxidation levels.

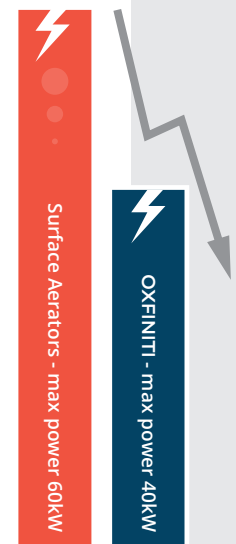
Objectives

- Measure energy consumption
- Identify power requirements
- Measure sludge Volumes
- Evaluate effect of Oxfiniti on ditch health

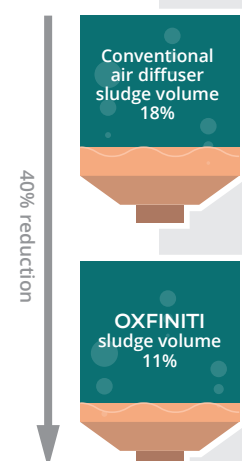
Results

- Reduced aeration energy consumption by 21% (258 kWh) a day without any optimisation.
- Max power requirements lower — surface aerators 60kW Oxfiniti 40kW,
- Sludge volumes reduced from 18% to 11%, a 40% reduction. This lowers operational costs by reducing sludge handling, transportation and disposal costs
- Water quality and plant health — significant improvements in visual appearance of secondary clarifiers.
- Significant reduction in ammonia levels. Lower levels compared to the existing surface aeration system. The more readily available molecular dissolved oxygen meant that the solids are more effectively digested by the micro-organisms

POWER REQUIREMENTS



POSITIVE SLUDGE CONSOLIDATION



Application	Type	OXFINITI Benefits
Municipal Wastewater	Supplement/ Retrofit to existing aeration systems New systems	 Improved basin health & performance • Improved Dissolved Oxygen levels (DO) • Reduced ammonia nitrogen • Reduced sludge Energy reduction profile • 30%+ reductions in usage compared to conventional aeration • Further reductions with control & customization • Energy optimisation: Value engineer with specific installed systems (example: utilise RAS return system and pumps) System • Closed loop – no impact to plant hydraulics • Rapid installation • Low maintenance
Industrial Wastewater	Wastewater	CBOD – similar benefits to above • Pulp & paper: improve basin health and reduce colour, etc. COD – depends upon application
Concrete Production	Reduction in cement use Improved performance	In tests in cement usage was reduced by 15%+ with similar performance capabilities: • Shortened cure times – improving construction efficiencies • Improved strength • Major impact on greenhouse gas due to reduced cement usage
Aquaculture	Aeration	The DO lifecycle tenor under Oxfiniti reduces low DO zones – improving product mortality The easier accessibility of the oxygen improves product growth rate
Emergency Oxygen Supply	Spills	Fast response to provide oxygen for milk and other spills in rivers

POTENTIAL REDUCTION IN CARBON EMISSIONS

WASTEWATER TREATMENT - Assumptions

- The water industry accounts for 6.34 GWh per day equivalent to 2314 GWh per annum.*
- 545 tonnes of CO₂ produced per GWh**
- Aeration used in ASP plants represents 60% of total energy costs = 1388 GWh***

OXFINITI mobile water treatment plant saves 30% energy in 10% of UK ASP plants: $1388 \times 0.3 \times 0.1 \text{ GWh} = 42 \text{ GWh}$
This equates to 22,890 tonnes CO₂ per annum ($42 \times 545 \text{ tonnes}$)

CONCRETE PRODUCTION - Assumptions

- **OXFINITI** used in 5% of pre-cast products
- Cement used in pre-cast concrete production accounts for 2.8m tonnes - 23% of annual cement production****
- Direct CO₂ emissions from cement manufacture = 700 kg/tonne****

OXFINITI saves approximately 15% cement.
CO₂ saving per annum: $= 2.8\text{m} \times 0.15 \times 0.05 \times 0.7 = 14,700 \text{ tonnes CO}_2$

* Parliamentary Office of Science and Technology ** Carbon Trust *** Soares 2008 **** Mineral Products Association



O2NRG LIMITED trading as **OXFINITI**

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