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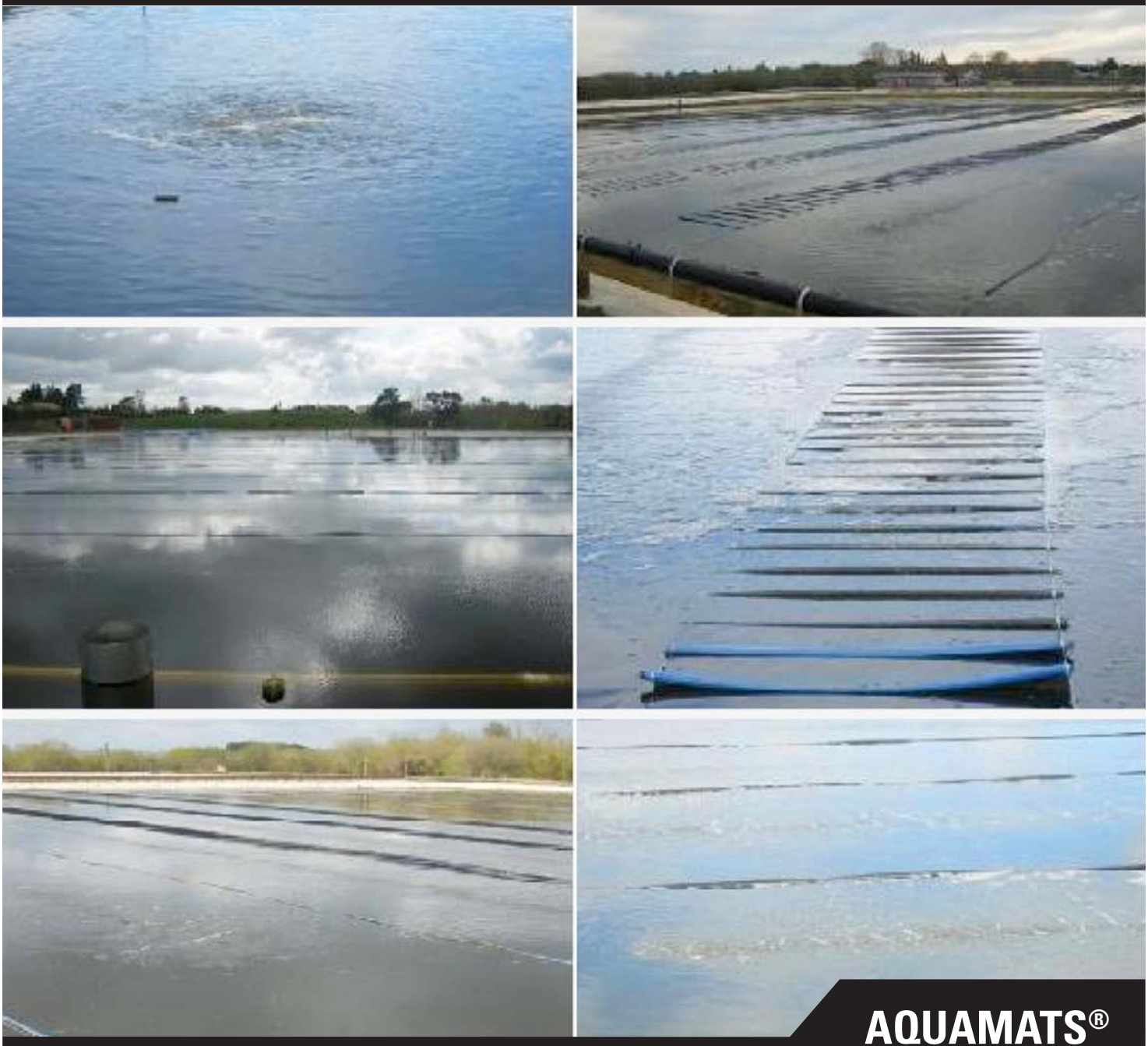
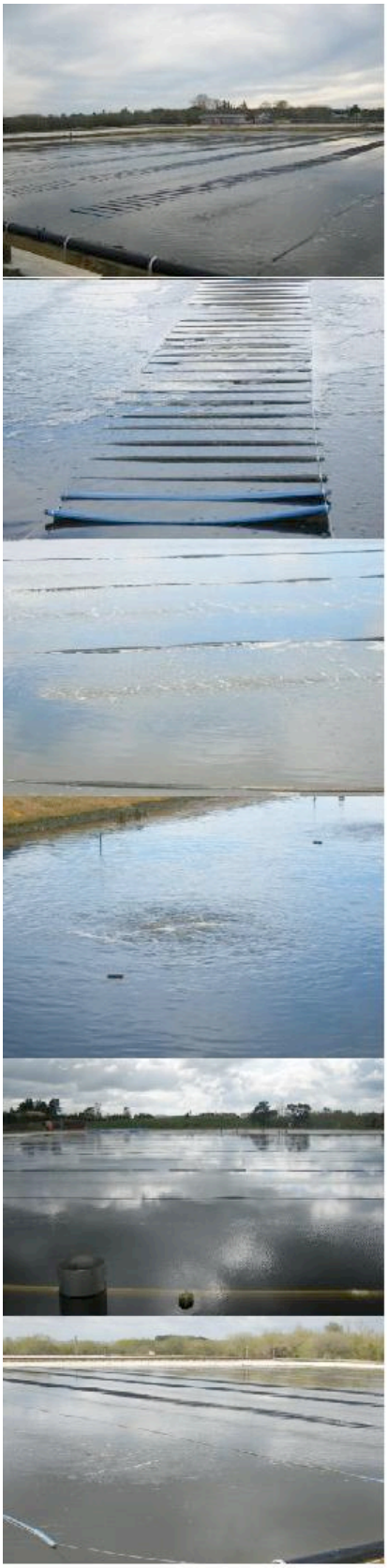


AQUAMATS®

ADVANCED MICROBIAL TREATMENT TECHNOLOGY FOR WASTE STABILISATION PONDS

KEY PRODUCT APPLICATIONS

» Municipal wastewater » Industrial wastewater » Dairy shed wastewater
» Abattoir wastewater » Piggery wastewater » Pulp and paper wastewater



THE AQUAMATS® PROCESS

ADVANCED MICROBIAL TREATMENT TECHNOLOGY FOR WASTE STABILISATION PONDS

Aerated lagoons have been used extensively in the past for treating municipal and industrial wastewater. Low capital investment, low operating costs and very limited maintenance requirements made this the affordable treatment of choice for many communities. Today, increasing loads combined with more stringent environmental constraints render many of these pond systems out of compliance.

AquaMats® Process technology provides a means to upgrade existing pond systems, improving discharge quality to meet new, higher standards and potentially increasing processing capacity by a factor of up to ten times. The AquaMats® upgraded system retains the inherent simplicity of operation and minimal maintenance requirements of the traditional Waste Stabilisation Pond with the economic benefit of maximised utilisation of existing infrastructural assets.

Capital costs associated with an AquaMats® upgrade will compare very favourably against alternative high rate, technology-intensive plant options. Operating costs and required operator skill levels will similarly favour the AquaMats®-upgraded pond system.

Originating in the United States, AquaMats® wastewater technology evolved from the intensive aquaculture industry where water quality standards are absolutely critical. Effluent nutrient loads from intensive fish and shrimps farms are frequently greater than typical loadings in municipal wastewater treatment plants. The successful use of AquaMats® in many aquaculture production facilities, achieving full recycling of water, made the transferal of the technology to municipal waste-water treatment applications a logical progression.

Today there are numerous references in the USA, Asia and now NZ, for the use of AquaMats® in the treatment of municipal and industrial wastewaters.

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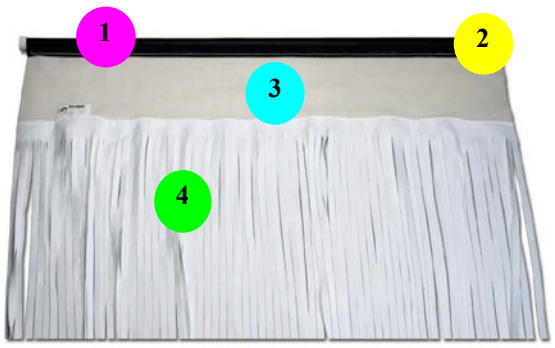
Description of AquaMats®

AquaMats® are a high surface area media designed to maximize colonization by beneficial bacterial and algal communities that inhabit the wastewater environment. In contrast to floating or fixed plastic growth media, AquaMats® are designed to promote an optimal environment for bacteria and higher organisms, creating a habitat similar to that found in natural ponds and rivers. The unique materials and construction make AquaMats® an extremely efficient surface media, resulting in the effective reduction of BOD, TSS and Ammonia.

Rows of AquaMats® at Columbia WWTP, Illinois, USA

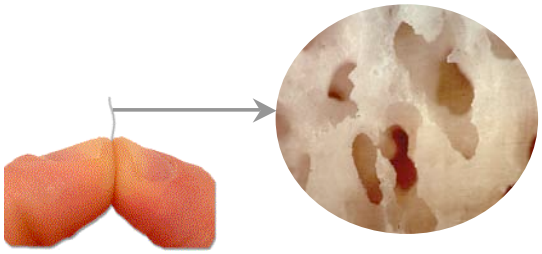
Biphasic Surface Area

AquaMats® offer a biphasic surface structure, a key component to the success of this product. During the production process, the fibres are woven at different densities on opposing sides of the fabric, designed to create a difference in the oxygen transfer rates. This rate differential results in a thin anaerobic or anoxic zone on one side of the fabric and an aerobic environment on the other. This contributes directly to both nitrification and denitrification occurring in close proximity on just the one surface area media, greatly enhancing the AquaMats® ability to accelerate the reduction of ammonia.



Fibre Design

The fabric of the AquaMats® incorporates fibres with a specifically designed porous surface, woven into a three-dimensional lattice. Strength is achieved by the solid core of the individual fibres and the base fabric into which the fires are woven. The result is a durable material with a very high specific surface area (effective surface area per nominal square meter of fabric). A specific range of pore sizes targets growth of selected organisms.



400x photo showing micropore structure of a SINGLE FIBRE from an AquaMat®. Each AquaMat® has millions.

The upper portion of the fabric, situated closest to the light source at the pond surface, has a larger fibre pore space and is targeted for colonization by sessile algal cells. The pore structure (1~10 micron range) of the lower fronds of the AquaMats® is tailored for microbial growth of bacteria.

Overall, this specific construction of the AquaMats® results in an effective surface area of approximately 240 m^2 per lineal meter of fabric.

Material Specifications

AquaMats® are constructed from fibres made of low density, condensed copolymers of polyethylene. This material is extremely inert and has been successfully tested for long-term durability (to EPA UV irradiation accelerated degradation standards). No plasticizers have been used in the manufacture of the fibres and life cycle testing using a series of alcohol and aldehyde extractants shows no leachate.

1) Float Sleeve – Highly UV resistant black coated woven polyethylene (encases float tube).

2) Float Sleeve Grommets - Stainless steel grommets at the ends of each unit.

3) Upper Fibre Layer – Open fibre matrix maximizes particulate precipitation and development of sessile algae colonies.

4) Lower Biphasic Layer – Woven fibre matrix providing microaerophylic space for biomass growth.

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"Increased Biodiversity generates greater ecosystem stability" Dr. Edward O. Wilson, Nobel laureate in Ecology

Pathways for Load Reduction

It is through the extensive colonization on and within the AquaMats® that a number of pathways become available for the reduction of the organic load entering the treatment plant. The microbial community consists of a diverse range of bacteria, viruses, molds, yeasts, fungi, protozoa, as well as a number of higher unicellular and multi-cellular organisms. These are all involved in many different complex reactions and interactions, ultimately converting nutrients into their final gaseous state (such as carbon dioxide and nitrogen). A parallel pathway is through the conversion of nutrients into mineralized tissue. This process results in nutrient reduction to a less soluble form. An end result is the settlement out of the nutrients in this form to the benthos.

Protein formation and assimilation of nutrients into cellular tissue is another major pathway for extracting nutrients from the pond system. Therefore, development up through the trophic levels is actively encouraged on AquaMats®, as this results in a very efficient incorporation of nutrients into biomass. In the US, fish have been introduced into WSP to graze on the AquaMats®. Subsequent harvesting of these fish for sale as cat food successfully combines nutrient reduction and sludge minimization.

Periphyton Community	Approx. Biomass	Number of Species
Algae	25%	21 ~ 150
Fungi	20%	>150
Bacteria	55%	>2000

Typical Microbial Community found on AquaMats®

Algal Competitive Interaction

Algal blooms in wastewater ponds or lakes can successfully be eliminated by the introduction of AquaMats®. AquaMats® create an ideal environment for the growth of sessile (attached) algae colonies. These directly compete with the pelagic (free-swimming) algae for the same nutrients. Pelagic algae expend a considerable proportion of their energy on adapting their position within the water column depending on the time of the day. Sessile algae don't have this same requirement, and can therefore more efficiently use the nutrients for growth. This energy expenditure differential results in the sessile algae out-competing the pelagic algae for the available nutrient resources, effectively blocking the free-swimming algae (such as blue-green algae) from entering the critical (and problematic) logarithmic growth phase.

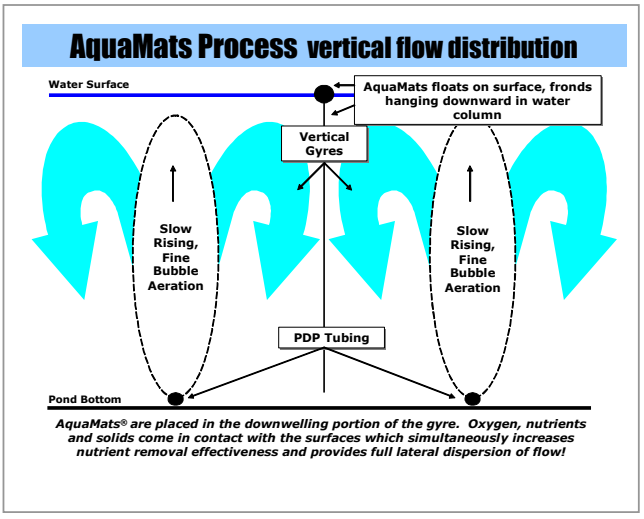
Pressure Differential Aeration

Integral to the AquaMats® system is the complementary aeration system, consisting of bottom laid, pressure differential piping (PDP) aeration from A.D.S. PDP piping is extremely efficient, simulating the mixing and aeration that occurs in natural waterways. As well as efficient oxygen transfer, the aeration also provides a gyre type mixing pattern which carries the nutrients across the surface of the AquaMats®.

Such benthic-deployed aeration has been used extensively in wastewater treatment over the past 35 years, with many reference sites throughout North America. Twenty years ago the original 0.013" open hole piping was replaced by the self-closing aeration systems. The self-closing system relies on internal pressure to open the air release slits cut along the length of the tubing, resulting in an even dispersion of fine bubbles into the water column. Unlike the previous designs, the PDP piping can be deployed over ponds with uneven bottom surfaces, as the operating pressure differential compensates for surface irregularities.

PDP Pipe Construction

The aeration tubing is a 19mm blended polyethylene pipe with integrated ballast. The slits are precision cut at varying intervals along the length of the tube. The number of slits per unit length controls the level of aeration, and the spacing between the rows of aeration lines allows for control of the mixing gyre that circulates the water within the pond. The PDP aeration system provides the ability to turnover the water within the total treatment pond once every 20 minutes utilizing only a minimum energy input.



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System Installation

AquaMats® are installed in continuous lines by attachment to a series of s.s. wire cables spanning the pond. Heavy equipment or support structures are not required in most applications. AquaMats® surfaces are designed to be self-cleaning and require very modest annual maintenance. AquaMats and PDP aeration pipes can be installed, relocated or added to new or existing pond system often without the need for prior desludging. Installation is achieved in an extremely short timeframe and often requires no modification to the existing treatment pond infrastructure.

AquaMats® are also hydraulic barriers. Specialised AquaMats® act as specific flow controllers.

Plug Flow – Hydraulic Barriers

AquaMats® also function has hydraulic barriers that substantially increase the settlement of suspended solids for bacterial fixation on both the media surface and in the benthic sludge. As well as enhancing the settlement of sediments, AquaMats® provide more idealized plug flow through the pond, optimising biological contact time and maximizing the true hydraulic residence time of the pond. Specialized AquaMats® Flow-controller products are available to create hydraulic barriers or to channel flow to further optimize treatment efficiency.

Installation	Type	Influent (mg/L)	Effluent (mg/L)	Comments
Municipal Plant 1 NZ	WWTP	BOD 240 TSS 192 NH_4-N 45	BOD 10 TSS 27 NH_4-N 0.7	Upgrade of existing plant, 1,580 AquaMats® used Commissioned Q4 2006
Municipal Plant 2 NZ	WWTP	BOD 156 TSS 156	BOD 8 TSS 8	Replacement WWTP 588 AquaMats® used Commissioned Q3 2007
Columbia, Illinois, USA	WWTP	BOD 90.4 TSS 95.3 NH_4-N 26.4	BOD 6.1 TSS 11.3 NH_4-N 0.62	1,540 AquaMats® used
Larchmont, Georgia, USA	WWTP	BOD 206 TSS 185 NH_4-N 24.2	BOD 6.7 TSS 12.9 NH_4-N 0.63	350 AquaMats® used
Frederick County, Virginia, USA	Largest Leachate Lagoon in USA	BOD 1060 TSS 750 NH_4-N 504	BOD 10.6 TSS 22 NH_4-N 5.3	Operating to <5 degrees Celsius
Tiger Hole, Jhongshan, China	Leachate trial facility for population >10 million	BOD 1800 TSS 750 NH_4-N 1500	BOD 55 TSS 67 NH_4-N 54	AquaMats® and aeration used less than recommended

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