Technical Data Sheet

USING BUBBLEBEAD FILTERS IN DIFFERENT APPLICATIONS

BubbleBead filters have been in use since the 1980s in a variety of different situations. They were developed following extensive research in the USA and have been applied to both foodfish (catfish, tilapia, striped bass, trout) and ornamental use (koi, coldwater and tropical ornamental fish, crayfish, clams, oysters, turtles, alligators). With foodfish they have been used in both broodstock and on-growing applications.

METHOD OF ACTION

The floating plastic bead media packs into a bed that both captures solids and breaks down wastes biologically. Technically it is described as an 'expandable granular biofilter'. The main advantages of the floating bead bed is that the backwash encourages the complete fluidisation of the bed and so removes much more waste from the filter than is possible with standard submerged bed filters. By using a stream of airbubbles to drive the washing process, the delicate biofilm on the surface of the beads is not unduly disrupted, and biofiltration continues with minimal interruption.

SOLIDS REMOVAL

BubbleBead filters have proved themselves to be excellent at water clarification. Virtually all particles above 50 micron size are removed in a single pass, largely through the straining abilities of the media bed. In a mature filter system a large proportion of smaller particles are also removed due to interactions with the biofilm. Even very fine particles (5 to 10 microns) are removed with a reported 48% removal in a single pass. Used in conjunction with ultra-violet clarifiers, even fine suspended algae will be controlled.

BIOLOGICAL FILTRATION

The floating media consists of specially selected beads of 2-3 mm size which give a good surface area for biological activity to take place (in excess of 1000 m^2/m^3). The thin biofilm that builds up on the surface of the beads contains many different types of filter bacteria including the essential heterotrophic and nitrifying bacteria.

The regular backwash removes solids which might otherwise clog the filter-bed and also removes excess layers of biofilm. However, unlike power washed media (which use paddles, propellers or water jets which can strip off the biofilm) the gentle bubblewash retains a thin and healthy layer of biofilm on the beads. By maintaining the biofilm at an optimal thickness, oxygen and ammoniacal nitrogen can diffuse efficiently into the film so maintaining a high capability for nitrification. This efficient biofilm is one of the main advantages of the compact BubbleBead units when compared to typical, bulky, submerged bed filters where excess biofilm growth and fouling significantly reduce nitrification efficiency.

CHOOSING THE CORRECT FILTER SIZE (see table 1)

The filter size is linked to the feed rate of the fish, the type of food fed, and the level of water quality that needs to be maintained. The figures on the colour brochure and website are based on ornamental fish such as koi.

For broodstock the highest water quality is required and maximum feed rates should be limited to half to two-thirds the feeding rates quoted for koi. For high-density on-growing systems the feeding rate can be up to double that quoted for koi providing the system is carefully monitored and closely managed. The slightly raised level of organic and nitrogenous wastes that can occur in the water at these high loading rates may limit such high density systems to only the more tolerant species.

It is also possible to use the BubbleBead filter as primarily a mechanical filter in conjunction with an appropriately sized trickle-bed filter (in series) or fluidised bed filter (in parallel) to provide additional biological filtration. In these cases the feeding rates can be as much as eight to twelve times the rates quoted for koi. Naturally, levels of aeration and close attention to system maintenance are essential in such extreme cases.

Table 1 FOOD LOADING RATES FOR BUBBLEBEAD FILTERS

Food Loading Rate per volume of beads	$\leqslant$ 4 Kg/m^3 *$\leqslant$ 113 gm/ft^3*	$\leqslant$ 8 Kg/m^3 *$\leqslant$ 225 gm/ft^3* These rates are quoted on the colour brochure	$\leqslant$ 16 Kg/m^3 *$\leqslant$ 450 gm/ft^3*	$\leqslant$ 32 Kg/m^3 *$\leqslant$ 900 gm/ft^3*	> 32 Kg/m^3 *> 900 gm/ft^3*
Applications This is a general guide. Please enquire regarding specific applications.	High clarity ornamental displays. Broodstock. Eggs and fry. Shellfish.	General ornamental displays. Koi & Goldfish ponds. Fingerlings.	On-growing of tolerant species. e.g. Tilapia, Carp, Rainbow Trout.	On-growing of tolerant species. Requires supplementary bio-filtration.	Solids removal only. e.g. Finfish feeding rates to 64Kg/m^3

Figures derived from operational filters. Based on 35% protein feed. Filter performance is affected by underlying water quality (see Table 2) and management practices.

REQUIREMENTS FOR BIOLOGICAL FILTRATION

As with all types of biological filter, the efficiency of the organisms in BubbleBead filters will be affected by the underlying water quality. The filters are likely to be less effective if the water falls outside the parameters listed in the table overleaf.

Table 2 UNDERLYING WATER QUALITY REQUIREMENTS	
Dissolved oxygen	A lack of oxygen will seriously limit nitrification as well as stressing fish. Good aeration of the water is essential. A minimum level of 2.0 mg/l should be maintained for nitrification (though this is much lower than many fish will tolerate).
pH	Nitrification activity will be higher if the water pH is in the range of 7.2 – 8.5. pH levels below 6.5 seriously reduce nitrification activity.
Temperature	Ideal nitrification performance is obtained at 20-30 °C (peaking at 25-30°C) though filters still function well at lower temperatures. Nitrification establishes more slowly at low temperatures and maturation of new filters can be very erratic where temperatures remain below 8°C.
Alkalinity	Nitrification reduces alkalinity. A reasonable level of alkalinity must be maintained e.g. 50 mg/l $CaCO_3$ minimum; ⩾ 150 mg/l for more highly loaded systems.

STOCKING DENSITIES and TURNOVER RATES

Densities of 10 to 60 Kg fish per m^3 have been obtained in practice. At such high stocking levels the minimum turnover rate for the system should be 2 times per hour. In less densely stocked ornamental systems, turnover can be reduced to once every two hours (or even three hours) if necessary. The flow rate through the filter should not drop below 25-30% of the maximum flow rates listed, so ensuring that sufficient nutrients and oxygen are supplied to the filter.

The maximum carrying capacity of fish for any particular filter can be calculated from the feed rate. e.g. a BBF-3 (with 3 ft^3 beads) on a tilapia system allows up to 1.35 Kg (3 x 450 g) of food per day. This in turn allows a stocking capacity of up to 135 Kg of fish at a 1% feeding rate, or 45 Kg of fish at a 3% feeding rate.

WATER CHANGE REGIME

The typical water change for systems run at full capacity averages between 4% and 9% per day and helps to keep nitrate levels in check. The automatic backwash facility, found as standard on hydraulic valve models, can help to achieve this water change if coupled with a topping-up system. Frequent backwashes (more than once a day) will reduce nitrate production still further, by removing more solids before they fully decompose. This assists in minimising the volumes required for water changes. Where makeup water lacks sufficient alkalinity it will be necessary to boost alkalinity by the regular addition of e.g. sodium bicarbonate, especially in high intensity systems.

SYSTEM DESIGN

Any system should be designed with adequate circulation in order to bring wastes into the filter system and to return oxygenated water to all parts of the filter tank. **All** systems with high stocking density benefit from additional circulation and aeration to help bring in oxygen and vent carbon dioxide. Air pumps with airstones are the most efficient method of aeration, but care should be taken to avoid any bubbles being drawn into the BubbleBead units during normal running.

If the filter is fed from a submersible pump or swim-pool style pump with strainer basket, the strainer must be accessible for regular cleaning. Where solids handling pumps are being used, some form of pre-strainer must be used. BubbleBeads are not intended to handle solids over 2mm in size.

Ornamental systems are usually run with a UV unit on the filter outflow to control free-floating algae and/or bacteria. Systems with moderate to heavy loading can benefit from the parallel use of foam fractionators. Heavily loaded systems can have the filtered water returned to the pond through a trickle tower or a rotating biological contactor to increase aeration and supplement biological filtration. Alternatively a fluidised bed filter can be run in parallel on such high stock systems provided levels of aeration are sufficient.

For safety in any system it is common sense to provide backup. e.g. It may be more appropriate to use two separate smaller pumps with two BBF-5 filters, than to use one pump with a larger BBF-9 filter. Any air pump could also be wired through an uninterruptible power supply. BubbleBead hydraulic valve filters drain automatically following a powercut, giving good survival of filter organisms compared to submerged bed filters.

Please contact the UK distributor with details of your specific application so that we can assist you in choosing the most appropriate size and configuration of filter equipment.

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Selected References -
AST technical literature, and:
Malone, R.F., Beecher, L.E., 2000. Use of floating bead filters to recondition recirculating waters in warmwater aquaculture production systems. Aquacultural Engineering 22: 57-73.
Malone, R.F., Rusch, K.A., 1998. Using the bead filter in your koi pond (Second Edition). Louisiana Sea Grant College Program. 50pp.
Drennan, D.G., Golz, W., Ahmed, H., Malone, R.F., 1995. Clarification abilities of floating bead filters used in recirculating aquaculture systems. In: Aquaculture Engineering and Waste Management, Proceedings from the Aquaculture Exposition VIII and Aquaculture Mid-Atlantic Conference, Washington, D.C., June 24-28, pp. 256-267.

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