PolyGeyser



BEAD FILTERS
DF-3 & DF-6

INSTRUCTION MANUAL

BEAD FILTER

The patented (U.S. Patent # 5,770,080 and 6,517,724) PolyGeyser Bead Filter is the newest addition to Aquaculture Systems Technologies' line of bead filters. Under development for several years, the technology exploits the biofilm protection provided by our Enhanced Nitrification (EN) Bead Media. Designed as "bioclarifiers" capable of performing both biological and mechanical filtration, these filters are capable of handling biological loads 50% to 100% higher than our Bubble-Washed or Propeller-Washed Bead Filters equipped with standard bead media. Additionally, the PolyGeyser Bead Filters offer a very high degree of reliability and are virtually immune to clogging and caking, since they backwash automatically without moving parts or electronics.

OPERATION

The PolyGeyser Bead Filter stands apart from AST's other Bead Filter technologies primarily through its automatic pneumatic backwash mechanism. Water is introduced below a bed of packed EN bead media and travels upward through the filtration chamber where mechanical and biological filtration takes place. Simultaneously, air is introduced into the air charge chamber at a constant, predetermined rate to achieve the desired backwash frequency. Once the charge chamber has reached capacity, the pneumatic trigger fires, releasing the entrained air from the charge chamber below the media bed. The sudden release of air from the charge chamber causes the beads to mix, roll and "drop" as the air agitates the beads.

The circulation pump/airlift operates continually, which ensures that the filter chamber begins refilling immediately after each backwash event. This causes the beads to float upward and reform as a bed. During the recharge cycle, suspended solids in the trapped backwash waters settle into the sludge storage chamber for later disposal via the sludge drain valve (usually every 2-3 days). At the same time, the supernatant is passed through the bead bed again as the air charge chamber is recharged with air.

The elimination of water loss associated with backwashing is a key element in this new technology. In most applications, dozens of backwash sequences can be automatically executed before sludge removal is required. There is no water loss associated with the backwash process and the water loss associated with sludge drainage is negligible. This strategy is particularly advantageous for marine systems, where the loss of saltwater and need for large backwash water treatment units are minimized.

The pneumatic strategy breaks the linkage between backwash frequency and water loss and allows the nitrification capacity of the unit to be fully utilized. Frequent backwash sequences have proven advantageous for optimizing the nitrification capacity of the unit. Numerous gentle scrubbing cycles promote high rates of nitrification by maintaining a healthy thin biofilm on the bead surfaces. Typical backwash cycles occur once every three to six hours. In recirculating bioclarifier applications, where the PolyGey er Bead Filter operates concurrently as a clarifier and biofilter, total ammonia nitrogen (TAN) levels below 0.3, 0.5 and 1.0 mg-N/l can be expected at feed loading rates of 0.5, 1.0 and 1.5 pounds feed per cubic foot of EN bead media (8, 16 and 24 kg-feed ms-3 day-1), respectively.

Bead Filters are Bioclarifiers

The term “Bioclarification” was coined some years ago by Dr. Ronald F. Malone, the inventor and patent holder of Bead Filter Technologies, to describe the ability of bead filters to perform both biological and mechanical filtration in the same unit. The ability of bead filters to perform these tasks is described in detail below.

Clarification

Bead filters perform well in the control of suspended solids across a broad spectrum of conditions. Bead filters capture solids through four identifiable mechanisms (Table 1). With the exception of adsorption, the solids capture mechanisms are physical in nature and are common to all types of granular media filters. As a general observation, the filters seem to control fine colloidal particles best with some biofilm development. This suggests that the biofilm absorption process is an important mechanism in the control of fine suspended solids and thus water clarity. Studies have shown that bead filters capture 100% of particles > 50 microns and 48% or particles in the 5-10 micron range per pass (Figure 1).

Table 1. Mechanisms Contributing to the Capture of Solids in a Bead Filter

Mechanisms	Comment
Straining	Direct capture of larger particles as they pass into small openings between the beads.
Settling	Sinking of suspended solids onto the surface of the beads.
Interception	Impact of particles directly onto the surface of a bed.
Adsorption	Small particles are captured and absorbed into the sticky biofilm.

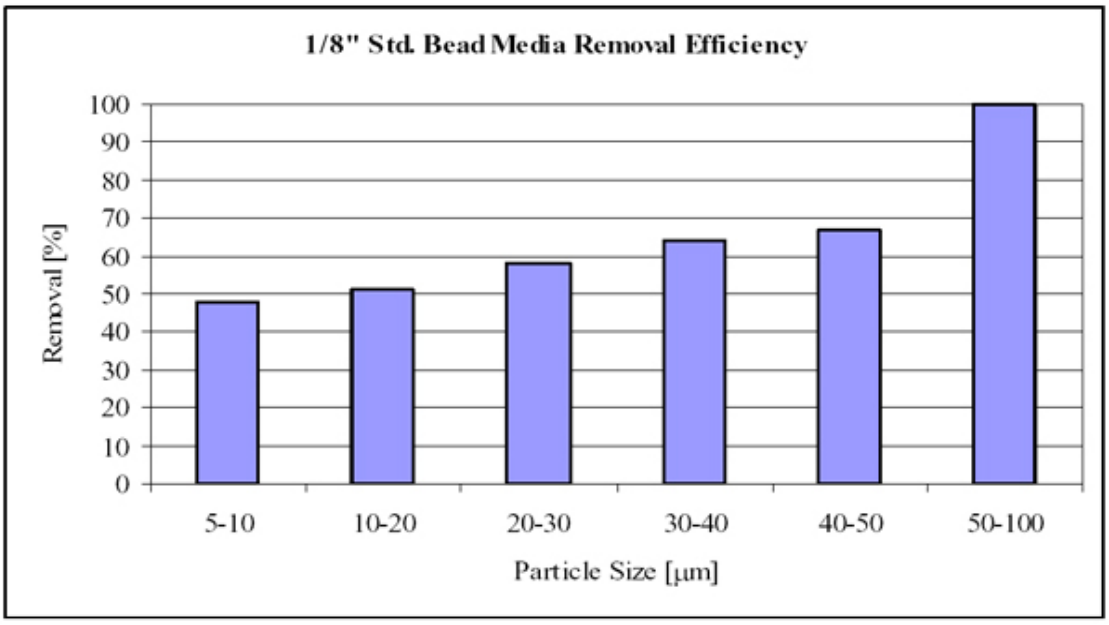


Figure 1. All particles above 50 microns are removed in the first pass through the filter and the remainders are removed with multiple passes.

The flowrate delivered to a bead filter is the principle management factor influencing suspended solids removal. The efficiency (single pass percent reduction in TSS) of a bead filter generally increases as the flowrate to the filter decreases; however, the capture rate (mass of TSS captured) tends to increase with flowrate. This apparent contradiction occurs because per pass efficiency is relatively insensitive to changes in flowrate, and so, minor drops in efficiency that occur with flow increases are more than compensated for by enhanced solids transport to the filter. Generally, recirculating rates used with closed or partially recycled systems should be maximized to obtain the lowest possible TSS level in the holding tanks.

Separation of captured solids from the bead bed is accomplished by sedimentation of released sludge after the bed is backwashed. Materials such as fats or wood chips merely float upward with the beads and are not removed. In sufficient quantity, these materials will eventually foul the bed requiring media replacement. Bead filters are also not well suited for the clarification of waters suffering from mineral turbidity problems caused by fine clays or other colloidal particles. Lacking good biofilm development, the mechanisms for the capture efficiencies are unacceptably low. Finally, the bead filters will impact but cannot control planktonic algal blooms. Although some capture occurs as a general rule, the algae can grow faster than they can be caught and thus little progress towards clarification is made. Application of the bead filter technology to the problem of colloidal minerals turbidity or algal bloom requires the use of supplemental treatments (chemical flocculation or U.V. disinfection, respectively) or the filter will be ineffective.

Biofiltration

In the biofiltration mode, bead filters are classified as fixed film reactors. Each bead (Figure 2) becomes coated with a thin film of bacteria that extracts nourishment from the wastewater as it passes through the bed. There are two general classifications of bacteria, heterotrophic and nitrifying, that are of particular interest (Table 2). The two bacteria co-exist in the filter, and understanding their impact on each other as well as on the filter is critical.

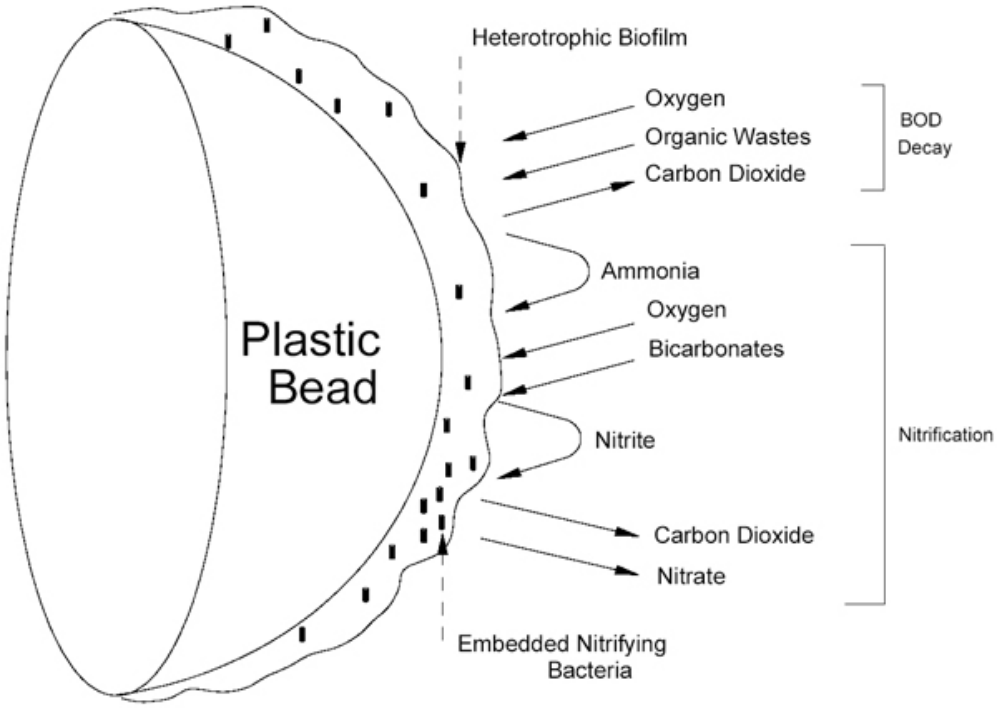


Figure 2. The bacterial film that coats each bead contains the nitrifying bacterial population. Heterotrophic bacteria also form a thin biofilm layer on each bead. The nitrifying bacteria compete with the heterotrophic bacteria for space.

.

Table 2. In the Biofiltration Mode, Bead Filters Cultivate Two Types of Bacteria which Perform the Critical Biofiltration Function.

	Heterotrophic Bacteria	**Nitrifying**
Function	Remove dissolved organics (BOD)from the water column; breakdown and decay organic sludges.	Convert toxic ammonia and nitrite to nitrate.
Reproduction Rate	Very fast (10 – 15 minutes)	Slow (12 – 36 hours)
Yield (mg bacteria/mg waste consumed)	0,6 – 0,8 mg	0,05 – 0,10 mg
Bead adhesion	Poor	Good

The classification of heterotrophic bacteria encompasses a great number of genera/species that share the common characteristics of extracting their nourishment from the breakdown (decay) of organic matter. Biochemical oxygen demand (BOD) is largely an indirect measure of the biodegradable organic material in water. Heterotrophic bacteria reduce BOD levels, consuming oxygen in the process. About 60 percent of the organic matter consumed is converted to
bacterial biomass; whereas, the balance (40 percent) is converted to carbon dioxide, water, or ammonia. Heterotrophic bacteria grow very fast, capable of doubling their population every ten to fifteen minutes. If the BOD in the water being treated is very high (> 20 mg -O2/l), the heterotrophs will quickly dominate the bead bed, overgrowing the slower growing nitrifying bacteria and consuming tremendous amounts of oxygen.

The second, yet more important, classification of bacteria is the nitrifying bacteria. These bacteria are specialists, extracting energy for growth from the chemical conversion of ammonia to nitrite and from nitrite to nitrate (Figure 3). Nitrate is a stable end product which, although a valuable nutrient for plants, displays little of the toxic impacts of ammonia and nitrite. Composed principally of two genera (Nitrosomonas and Nitrobacter), nitrifying bacteria are very
slow growing and sensitive to a wide variety of water quality factors. It is not surprising that most bead filters used for biofiltration are managed to optimize conditions for nitrification.

FILTER ACCLIMATION

Development of a biofilm layer on the media is required for biofiltration. The bacterial culture, which grows attached to the beads, performs the biochemical transformations that are so critical in the purification of recycled waters. Initially the biofilter has no bacteria and the culture must be started. The process of growing the initial bacterial culture in the biofilter or adjusting an established culture to a change in loading is called acclimation. Fortunately, the process of biofilter acclimation is easy. It just takes a little time and food for the bacteria.

The best way to acclimate a recirculating system with a biofilter is to just add a few hardy fish, turtles, or mollusks to the system and start to feed them. The total suspended solids in the system will pose no problem because bead filters capture solids primarily by physical processes that are not dependent on the development of a biofilm. The heterotrophic bacteria will grow rapidly and quickly attach themselves to the beads, so BOD accumulation should pose no problem. The nitrifying bacteria, however, are very slow reproducers and may require almost thirty days under warm water conditions (2 - 3 weeks is more typical) to establish themselves.

To help nature a little we recommend the use of liquid, living, bacterial products like Microbelift SuperStart, Microbelift Nite Out, Microbelift Gel, Bacta-Pur Klear.

NOTES ON NITRIFICATION

When ammonia removal is desired first start with MICROBE-LIFT Clean & Clear to reduce the organic waste in the pond as high levels of BOD can inhibit nitrification by competing with the nitrifying micro organisms for necessary oxygen. After applying MICROBE-LIFT Clean & Clear wait 24 to 48 hours to do its job, and then apply MICROBE-LIFT NITE-OUT II. Prior to the addition of NITE-OUT II (to start and maintain nitrification). Check to make sure that the pond' pH is in the correct range for nitrification. Adjust the pond pH to a range of 7.5 to 8.7, and check to see if adequate alkalinity is present as you must maintain a level of at least 50/ppm of alkalinity at all times. This is necessary as nitrifying micro organisms use 7.1 lbs of alkalinity for each pound of ammonia removed (oxidized). If proper alkalinity is not present, nitrification will not occur, and if alkalinity is lost nitrification will cease and the pond pH will drop due to the nitrifying cultures activity. To increase alkalinity add Bacta-Pur Bio-Balance until you achieve an alkalinity level of 50/ppm to 100/ppm (minimum), and then maintain the alkalinity at a level of 50/ppm.

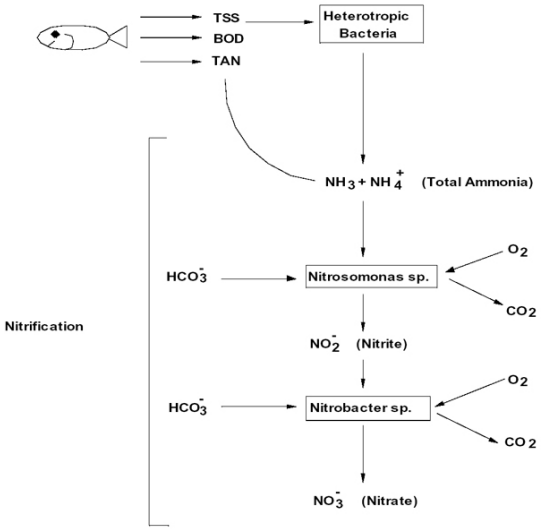


Figure 3. Two specialized types of nitrifying bacteria convert toxic ammonia and nitrite to the relatively safe nitrate. Bicarbonate ions and oxygen are required in large amounts.

IMPORTANT: During acclimation the backwash frequency of your PolyGeyser filter should be 1-2 backwashes per day. This will keep the bead mixed and promote homogenous growth of nitrifying bacteria throughout the bead bed.

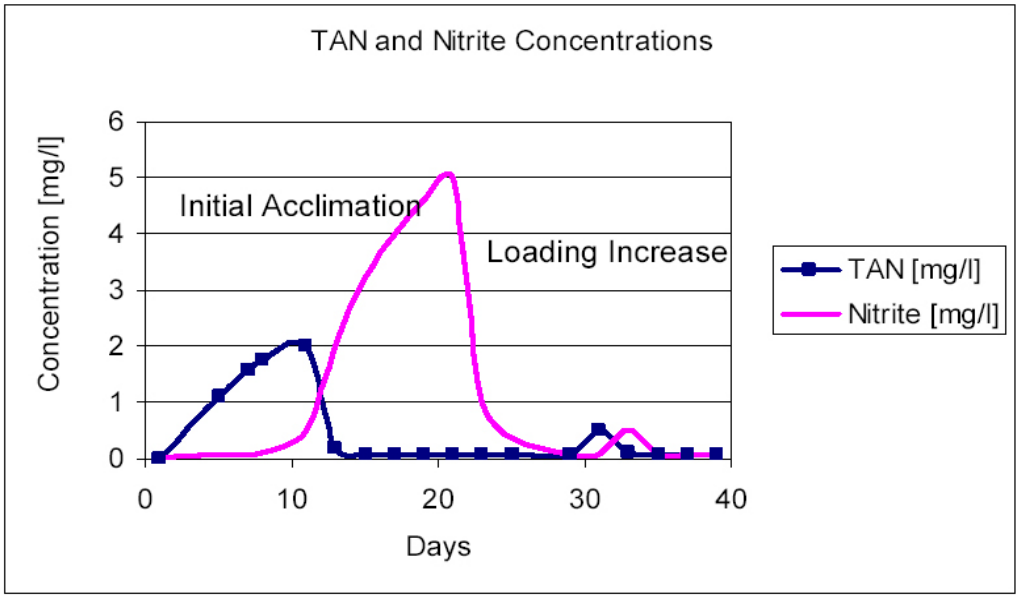


Figure 4 illustrates the classical pattern of TAN (total ammonia nitrogen) and nitrite concentrations observed during filter acclimation with animals. The process starts with an increase in TAN concentrations. You will know that the first group of nitrifiers responsible for ammonia conversion to nitrite are present in large numbers when the ammonia excreted by the fish stops accumulating and suddenly (within 36 hours) drops to near zero levels. At the same time there will be a sudden rise in nitrite levels, followed by a gradual increase which will continue until suddenly the second group of bacteria, Nitrobacter, catch up with their new food supply and the nitrite concentrations plummet. The filter is now considered acclimated to a light loading. This initial stage of acclimation is critical because during this period populations of bacteria which can effectively attack the specific waste produced by the animals become established and these bacterial populations adjust to operate under the water quality conditions and temperature regime found in your system. This unique culture of bacteria will remain in the biofilter for years if it is just treated with a little common sense.

Table 3 summarizes things you can do to accelerate the initial acclimation of the bead filter. These procedures can reduce acclimation time to as little as two weeks in a warm freshwater system. One of the principal limitations of acclimating a filter with animals is that little or no nitrite is available for the growth of Nitrobacter until the Nitrosomonas population has become established. This means that the very slow growing Nitrobacter cannot even get started for over a week. Therefore, you can simply reduce the acclimation time by adding nitrite at the start. The acclimation process becomes moot if you have an acclimated bead filter on your premises. Just exchange a few cubic feet of acclimated beads from the old filter with new beads and both filters will adjust rapidly. Lacking the beads, have a friend provide you with backwash waters from an established filter. Just dump the sludge into the system. The bead filter will pick it up and leave the solids in intimate contact with the beads where the transfer of desirable bacteria will rapidly take place.

	Procedure	How does it help?
1	Add sodium nitrite at a concentration of 1 mg-N/I on the first day.	Allows growth of Nitrobacter to start immediately.
2	Add backwash waters or beads from an established biofilter. *	Introduces species/strains of bacteria that are well suited for the bead filter's ecosystem.
3	Reduce Filter Backwash Frequency	Minimizes the loss of biofloc.
4	Raise the temperature of the system to 30° C. (Aquaculture, different for ponds).	Accelerates bacterial growth rates by increasing metabolic rates.
5	Adjust the ph to 8.0.	Accelerates bacterial growth rates by increasing ammonia (NH_3) concentrations.
6	Add sodium bicarbonate or Bacta-Pur Bio-balance to raise the alkalinity to 150 mg-$CaCO_3$/l	Accelerates bacterial growth rates by increasing biocarbonate availability.
* Disease may be spread with the biofilm, so make sure the source is healthy.		

MOTE: Most of these procedures come from the (American) aquaculture (fishfarms) and are not always useful for (koi)ponds. Ask your (koi)dealer for advice.

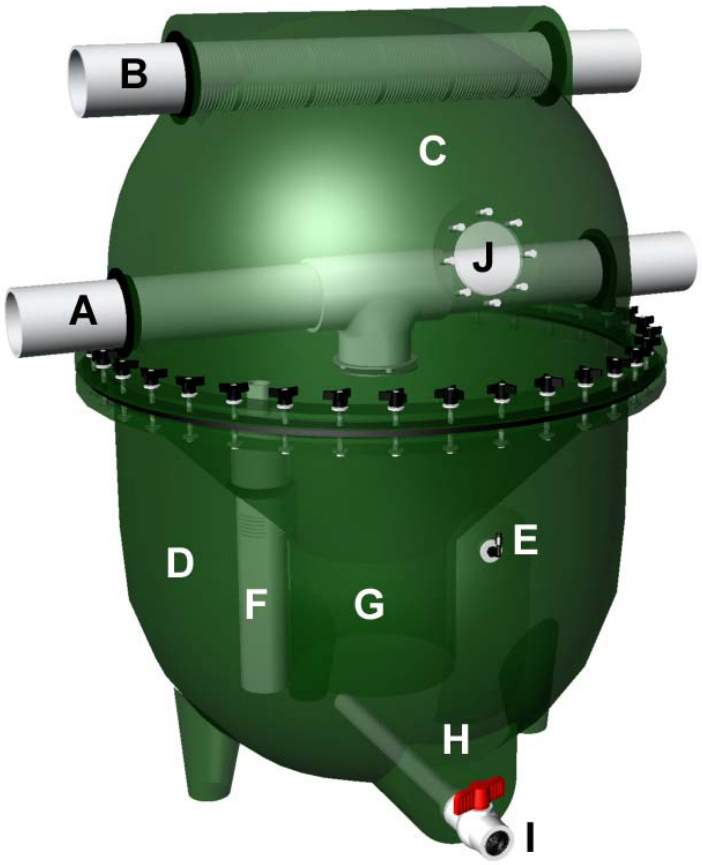
You should be careful not to kill the animals which are used to acclimate the filter. The animals you select to use do not need to be the same as you will be culturing. The best choice for freshwater systems is turtles. The ammonia and nitrite concentrations that will be reached will not affect these animals. So you do not have to worry. In-expensive domestic Koi or goldfish are good choices if fish are used. However it is important that the fish or animals used during acclimation are disease so as not to infect your high quality fish later. These animals can tolerate short-term exposure to TAN and nitrite levels of about 5 mg-N/l without harm if you keep the pH between 7.5 and 8.0 and add some sodium chloride (rock salt) or calcium chloride. Chlorides help prevent nitrite toxicity by blocking nitrite transfer in the gills. The pH range keeps the TAN in the less toxic NH4+ form. It is usually the nitrite peak, which is twice to three times as high as the TAN peak, which damages the fish. If the fish show signs of stress (inactivity, lack of hunger, or gaping near the surface), remove them; you will have plenty of food for the bacteria in the water column already. The fish should be reintroduced into the system once both the TAN and nitrite levels fall below 1 mg-N/l.

The initial acclimation assures that the biofilter contains the right type of bacteria. However, you then must adjust the amount of bacteria to assure there are enough of them to process the ammonia produced by the animals in the system. So the next step in the acclimation process is to increase the density of animals in moderate steps allowing some time for the bacterial population to grow to meet the increased demand. This process of acclimation to increased loading is normally undertaken with the animals of choice, since the TAN and nitrite peaks are small and quickly disappear. As a general statement, an acclimated filter will completely adjust to a sudden increase in fish density (or feed level) within 72 hours. If the step increase is moderate (< 33 percent of current load), the acclimation will probably occur without noticeable peaks. The heights of the acclimation peaks are actually controlled by the density of fish in the system, not by the size of the biofilter. That is, the nitrite peak in a system with a fish density of 0.25 pounds/gallon will display a peak concentration one-half as high as a system with a density of 0.5 pounds/gallon. Table 4 summarizes additional methods that can be used to decrease transitional peaks. The process of acclimation to increased loading occurs naturally if the bacteria and animals are allowed to grow together. The bacteria always grow faster, maintaining the proper balance between the biofilm and the animal density. For example, within a Koi pond, once the filter is acclimated to the fingerling density, the biofilter's ecosystem will take over and maintain the proper balance. Your management responsibility occurs when the natural growth processes are disrupted by sudden (unnatural) changes in the system.

Table 4. Things that Can be Done to Decrease Transitional Peaks of TAN and Nitrite When the Animal Density or Feed Rates are Increased

	Procedure	**How does it help?**
1	Increase your waterloss from the system until the biofilters adjusts.	TAN and nitrite will be flushed with the water.
2	Discontinue or reduce feedrate during the transition.	TAN excretion rates from most animals increases with feeding.
3	Make loading increases in small increments (< 33% of current load) and separate steps by about 3 days.	Existing bacteria will absorb most of the increased load and reproduce rapidly.
4	Extend backwashing interval.	Decreases biofloc loss during the critical transition.
5	Adjust pH and alkalinity to optimum range.	Accelerates reproduction of nitrifying bacteria.
6	Artificially increase the TAN loading prior to the increase by dosing of ammonia chloride (NH4CI) and sodium nitrate (NaN02) to a level of 1 mg-N/I.	Promotes growth of the critical nitrifying bacteria, enriching their density in the biofilm.

MOTE: Most of these procedures come from the (American) aquaculture (fishfarms) and are not always useful for (koi)ponds. Ask your (koi)dealer for advice.



PolyGeyser Bead Filter Major Components

Filter Specificaties	US Units	Metric Units	US Units	Metric Units
Model	PolyGeyser DF3	PolyGeyser DF3	PolyGeyser DF6	PolyGeyser DF6
Height	47″	1.20 m	54″	1.37 m
Diameter	33.25″	84.5 cm	41″	104 cm
Shipping Weight	175 lbs	80 kg	350 lbs	155 kg
Bead Media Volume	3 ft3	85 L	6 ft3	255 L
Max. Flow Rate	45 Gal/min	170 L/min	90 Gal/min	330 L/min
Max. Pressure	10 PSI	0.7 bar	10 PSI	0.7 bar
Air Volume for Backwash	4.5 ft3	127.43 L	9 ft3	254 L

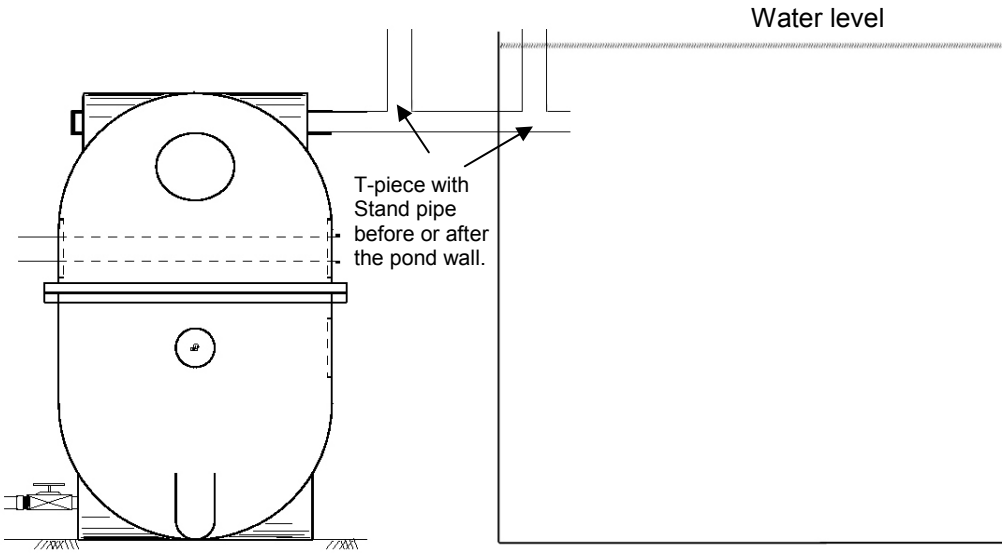
Major Component List– Standard configuration

Item	Description
A	DF3: 3″ (± 76mm) Water Inlet, DF6: 4″ (±100mm) water inlet.
B	DF3: 3″ (± 76mm), DF6: 4″ (±100mm) water outlet with 1,7mm slots to keep the beads inside.
C	Filter chamber
D	Charge Chamber Housing
E	Air inlet 4 mm
F	Trigger pipe for backwash initiation
G	Drop Chute
H	Sludge Storage Zone
I	Sludge drain slidevalve (comes standard with fittings for connection) with 1,7 mm screened pipe to keep the beads inside.
J	Window

INSTALLATION

In order for the filter to operate properly, it must be set up on a flat level surface. If the filter is not level, the air charge chamber may "short-circuit", allowing air to escape from the charge chamber before a complete charge has been established, thus air will continuously burp up through the drop chute. If this occurs the trigger will not fire and the filter will not backwash. To correct this issue simply level the filter.

The PolyGeyser can be installed above or under the water level of the pond. The return to the pond also can be above or under water level. When the return will be installed under water level, air will enter the pond during the backwash procedure. When this air is not appreciated you can install a T-piece with "standpipe" above the water level in the return pipe. The air will escape through this pipe during backwash. The standpipe can be situated before the pond or in the pond. In the figure we show a schematic drawing of this standpipe:



Tip: put a pvc bend of 45° or 90° on the stand pipe in the direction of the pond to prevent the upcoming water from going over the edge of the pond or filter area.

Pump connection

The PolyGeyser comes standard with:
1 x transparent checkvalve, 2 x reduction socket to 63mm, 2 x white 3" (DF3) or 4" (DF6) endcaps, 2 x black flexible reduction sockets with clamp to connect the pump and the return pipe. (DF6: 2 x reduction sockets 90/110-63).

Be sure the PVC parts are cleaned well before using glue.

Use 63mm PVC pipe and long bends 63mm (optional) in stead of short bends (more head pressure).

Connect the pressure side of the pump with the reducing socket of the checkvalve. Be sure that the checkvalve is positioned well (white flap has to be on the lower side, as on the picture) to prevent the beads from going back into the pump.

When it is not possible to install the checkvalve vertically you can also mount it horizontally. Be sure to position the valve exactly straight in this case.

The black flexible connectors are used for connecting the pump and the return pipe. The unused in/outlet will be closed with the supplied white end caps.



Pressure side
pump enters here

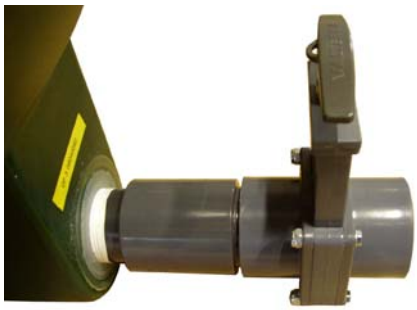
Sludge drain connection

The PolyGeyser comes standard with:
1 x Valterra slidevalve 50mm, a piece of pipe PVC pipe Ø50mm (DF3), a reducer socket 1½" inch to 50mm (DF3). The DF6 comes with a reducer from 2" to 63mm where the slidevalve fits in (outer diameter of the slidevalve is 63mm).

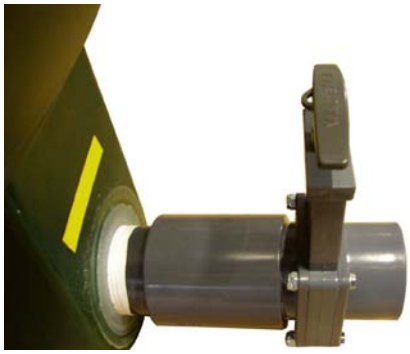
Be sure the PVC parts are cleaned well before using glue.

DF3: Attach the reducer socket to the piece of pipe that comes out the PolyGeyser. Connect the piece of pipe in the reducer socket. Connect the slidevalve with the pipe.

From the slidevalve you can make any further pipe conncetions.



DF3



DF6

Connecting the flowmeter.

The PolyGeyser comes standard with:
1 x flowmeter, 1 x mounting bracket for flowmeter,
5 meter airhose 4 x 6mm, 1 x non return valve 4mm.

Mount the flowmeter in the bracket. Unscrew one of the screws of the PolyGeyser. Put the bracket over the threaded part and return the screw. (see picture). With the supplied air hose you can connect the air pump to the lower inlet of the flowmeter. The air hose can be put into the flowmeter until it can get no further. To release the air hose push the blue ring and pull out the air hose. Use a short piece of hose from the upper connection of the flowmeter to the "black end part" of the non return valve. Use another piece of air hose to connect the other end of the non return valve to the inlet of the PolyGeyser. Please check if all connections are tight.



The flowmeter has a range of 0,2 - 2 liter per minute. The amount of air blown into the filter determines the backwash frequency. The optimum frequency of backwash intervals varies with feed loading. The table below presents recommended backwash regimes and associated air flowrates.

Feed Loading Rate	Air Flow	Backwash Frequency (DF3)	Backwash Frequency (DF6)
Up to 650 gms	0,35 ltr/min.	4 / day (every 6hrs)	2 / day (every 12 hrs)
Up to 1,35 kilo	0,7 ltr/min.	8 / day (every 3hrs)	4 / day (every 6 hrs)
Up to 2 kilo	1 ltr/min	12 / day (every 2hrs)	6 / day (every 4 hrs)

!!! IMPORTANT !!!

After installing the filter it is necessary to set the backwash frequency at the highest rate possible for 24 hours to facilitate the movement of the bead media from the charge chamber to the filtration chamber. During shipping, the beads naturally migrate into the charge chamber. Multiple backwashes are required to flush them from the charge chamber once the filter is placed into operation.

PUMP SELECTION

The PolyGeyser is designed as a low-head filter. Operating pressure should therefore not exceed 10 PSI (0.7 bar). Installation of devices causing excess backpressure on the discharge side of the filter should also be avoided.

Recommended pumps:
Messner, Oase, Sequence, Red Dragon. As long as the **NETTO** flow does not exceed 15.000 l/h (DF6: ±25.000 l/h) and the pressure is not more than 7 meter, every pump can be used.

The installation of heaters and UVC-units is recommended in between the pump and the PolyGeyser. During backwash the return pipe will be temporarily dry because of the escaping air. It will be no problem to install the heater or UV before the filter.

Trouble Shooting

I Cannot See the Beads in the Window

• After installing the filter it is necessary to set the backwash frequency at the highest rate possible for 24 hours to facilitate the movement of the bead media from the charge chamber to the filtration chamber. During shipping the beads naturally migrate into the charge chamber. Multiple backwashes are necessary to flush them from the charge chamber once the filter is placed into operation.

The Beads Seem to Be Fluidizing / I Can See Under the Bottom of the Bead Bed Through the Window

• The PolyGeysers are designed for a max. flow rate. If you exceed this flow rate you can cause the beads to fluidize. To correct this problem simply reduce the flow through the filter.

My Flow Rate Is At Or Below recommendation And It Still Appears That The Beads Are Fluidizing

• The inlet injection line has three flow interrupters installed in it to equalize the flow of water through the inlet pipe along the length of the inlet pipe. If your injection line is installed so that it enters the inlet line at an upward angle, it is possible to inject the water above the flow interrupters in which case the water jets from the inlet pipe cause fluidization. This is common in installations using flexible PVC pipe to connect to the inlet line.

Levelling

• In order for the filter to operate properly, it must be set up on a flat level surface. If the filter is not level, the air charge chamber may "short-circuit", allowing air to escape from the charge chamber before a complete charge has been established, thus air will continuously burp up through the drop chute. If this occurs the trigger will not fire and the filter will not backwash. To correct this issue simply level the filter.

• If the filter is level and the trigger still does not fire properly, raising the trigger 1/8" to ¼" may be required. Note we test fire each trigger at AST to ensure they are set correctly before and after we add the bead media to the filter. The trigger should be set as low as possible against the uni-seal and the air inlet holes must be below water level. Also ensure that the trigger is level. To re-set the trigger you must drain your filter, remove the beads and unbolt and remove the top half of the filter unit. Once you have done this refill the filter with water, ensure that the trigger is full of water and turn on your backwash air at a rate high enough to initiate a backwash within several minutes. This will allow you to observe what is actually occurring. If air bubbles come up the drop shoot before the trigger fires, then you do, in fact, have to raise the trigger. To raise the trigger simply grasp it firmly and pull it up 1/8" to ¼". Note the higher you set the trigger the less volume of air available during a backwash. To ensure a vigorous backwash the trigger should be set as low as possible. Before attempting to raise the trigger I suggest you contact the dealer from whom you purchased your filter.

Elevated Nitrite (NO_2) Levels

• Elevated levels of Nitrite may occur if the dissolved oxygen concentration in the effluent leaving the filter drops below 2 mg/l. Low DO concentrations leaving the filter can often be solved by increasing the dissolved oxygen levels in the tank or pond through increased aeration or by increasing the flow rate through the filter.

• Elevated Nitrite levels may also occur if your total alkalinity (as $CaCO_3$) drops below 80mg/l. We recommended you maintain your alkalinity at 100-200 mg/l as $CaCO_3$ at all times. If you experience low alkalinity you can add KH increasing products like Bacta-Pur Biobalance to the system periodically to maintain proper levels.

• Elevated Nitrite levels can also occur from over washing the bead bed. If the flow rate, effluent oxygen and alkalinity are satisfactory, the backwash frequency can simply be

reduced. This situation typically occurs when you go from periods of high loading and frequent backwashing to periods of reduced loading but still maintain frequent backwashing.

Low Effluent Dissolved Oxygen

• Low Effluent Dissolved Oxygen concentrations are usually the result of too low a flow rate. Effluent D.O. concentrations should be maintained above 2 mg/l at all times. If you are not flowing water through the filter at the filters maximum flow rate simply increase the flow through the filter.

• Or you can increase the amount of aeration in the tank or pond to increase influent D.O. concentrations which will usually result in increased effluent D.O. concentrations.

• Low DO concentrations may also occur if the backwash frequency is set too low. If the bead bed is allowed to clog, reduced flow and effluent oxygen concentrations will occur, which will affect the nitrification performance. Please refer to "Backwash Frequency" section for recommended backwash frequencies at various feeding rates.

• Low D.O. concentrations can also result if you do not remove sludge and waste from the filter often enough. The sludge should be drained every 2-3 days to prevent excessive oxygen consumption by the activity of heterotrophic bacteria. Pressure Loss/Reduced Flowrate

• Pressure loss and subsequently reduced flowrates may occur if the backwash frequency is set too low. The filter is designed to backwash frequently with minimal energy input, so if you do not backwash frequently enough the bed may clog. To overcome this problem simply increase the air flow to effect a more frequent backwash.

• If this does not solve the problem, check the outlet screen for clogging and clean if necessary.

Sulfide Production

• Sulfide production in the PolyGeyser filter can occur in the offline sludge storage basin.

These sulfides are isolated within the sludge. Water slowly returned to the pond from this basin may contain a low level of sulfides, however, it is first diluted by the recirculating flow (at a ratio of over 100 to 1) and then must pass through a two foot aerobic bead bed. The aerobic bed assures any sulfide residuals are converted to the safe sulfur form of sulfate. The processes that produce the sulfides are identical to the natural processes that occur in the bottom of virtually every mud pond and are instrumental in the recycling of trace elements essential for plant and fish nutrition. Sludge storage in the off line basin is a matter of convenience, the filter's operation does not require it, but, given the fact that there has been no observation of sulfide accumulation in any tank or recirculating pond waters, there seems to be no reason not to take advantage of this time saving feature. Sludge is

Slow to Drain from the Filter

• Sludge normally drains rapidly from the filter, but now drains very slowly. The screen on the sludge discharge line may be clogged. Cleaning it may be as simple as connecting a garden hose to it and flushing the line. If this does not solve the problem it may be necessary to remove screen for cleaning. Simply turn off the flow of water to the filter. Drain the filter completely. Loosen and disconnect the rubber couplings on the inlet and outlet lines, tilt the filter back so the beads slide away from the sludge valve and unscrew the sludge valve assembly. After cleaning the screen, apply Teflon tape or thread sealant to the threads and screw the sludge valve assembly back into the filter. Note after re-starting the filter it may be necessary to backwash the unit multiple times to release any trapped beads from the charge chamber.

• If your system is heavily loaded and the screen clogs frequently you can remove it and operate the system without a sludge screen. However, you should be aware that if you operate the system without a sludge screen you may experience a small amount of bead loss during sludge removal.