DIY Foam Fractionator

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INTRODUCTION

Background

All koi ponds contain levels of at least four different types of pollutants that we, as koi keepers, should try to reduce to the minimal possible level. We want our koi to thrive, and not just survive.

TYPE OF POLLUTANT	EXAMPLES
Insoluble Organics	Pieces or algae or other plants, fish feces, uneaten food
Soluble Organics	Dissolved Organic Compounds (DOC) where are molecules of amino acids, decayed organic waste, tannins from plants, and other organic compounds
Insoluble Inorganic	Indirect pollutant consisting of objects such as rock and gravel that trap and hold organic waste
Soluble Inorganics	Nitrogen compounds such as ammonia, nitrite, and nitrate

There are many different solutions for addressing each type of pond pollutant.

TYPE OF POLLUTANT	SOLUTIONS
Insoluble Organics	Excellent mechanical stage filtration such as a Rotary Drum Filter (RDF), sieve, rows of brushes…etc.
Soluble Organics	Showers, trickle towers, and foam fractionators that can separate DOC from the water column into foam that can be removed.
Insoluble Inorganic	Do not add anything to the pond walls or floor to trap and hold organic wastes.
Soluble Organics	Use filters designed for nitrification to provide a home for bacteria that will convert ammonia to nitrite to nitrate. Use denitrification filters and/or water changes to minimize the level of nitrates.

Project Objective

To provide a cost-effective solution for minimizing DOC in a pond system designed for koi.

Goals

The project goals are to deliver a solution that:

1. Decreases pond DOC levels
2. Immediately increases pond water aeration which good for koi and for nitrification
3. Reduces pond ammonia and nitrites (perform nitrification)

Problem

Pollutants that are on the molecular level, such as DOC, are not easy for traditional pond filters to capture and remove.

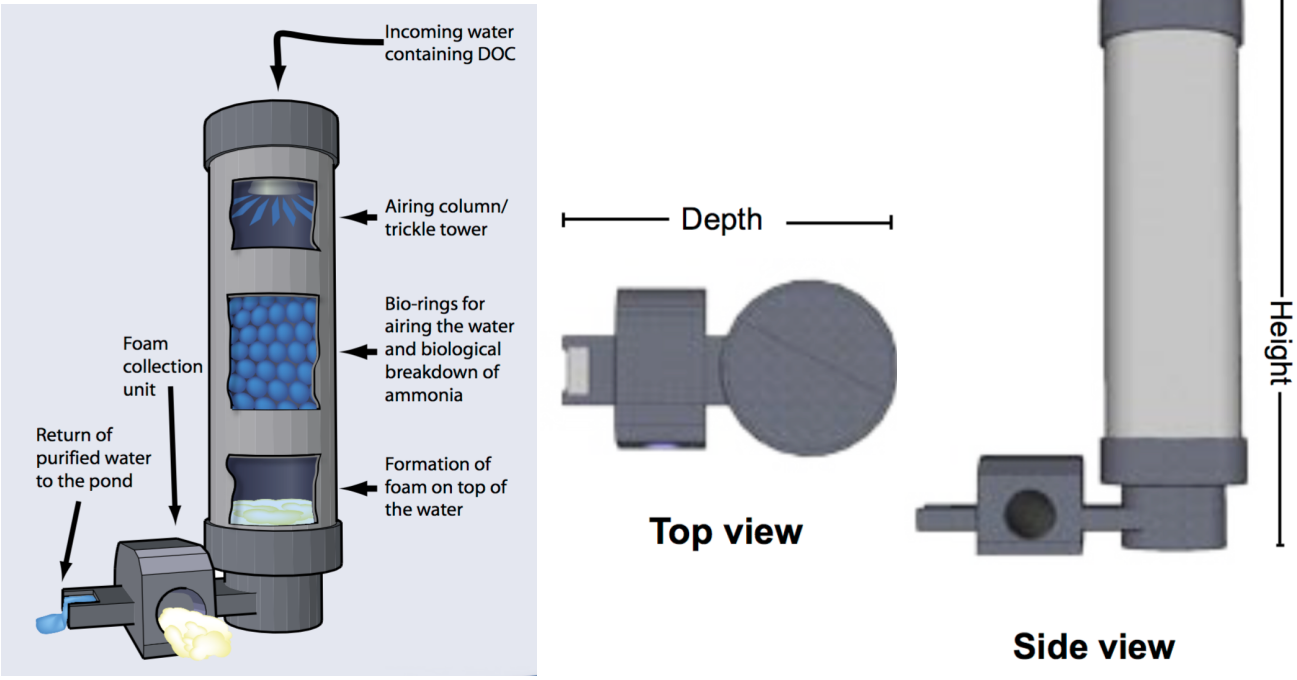
Solution

Protein Skimmers or Foam Fractionators remain the preferred choice for removing DOC from water.

Foam Fractionators, work on the principle that most DOC and nutrients in the water have bipolar properties, meaning that one part of the compound prefers air and the other part prefers water. This means that these compounds are attracted to the air bubbles in the water, where there is an interphase between air and water. When sufficient DOC has bound to the air bubble, stable foam is created and collected. The smaller the air bubbles, the larger surface area and more effective the Protein Skimmer or Foam Fractionator works. This the principle that turns milk bubbles into foam when a child blows air into it with a straw. The bubbles mix the air and milk proteins into a foam because proteins cling to the air bubbles. The foam rises and can be separated from the liquid.

Commercial Fractionator

Are there existing commercial foam fractionator products available for koi pond systems? Yes, the Clarity line of products was introduced into the koi hobby marketplace around 10 years ago.



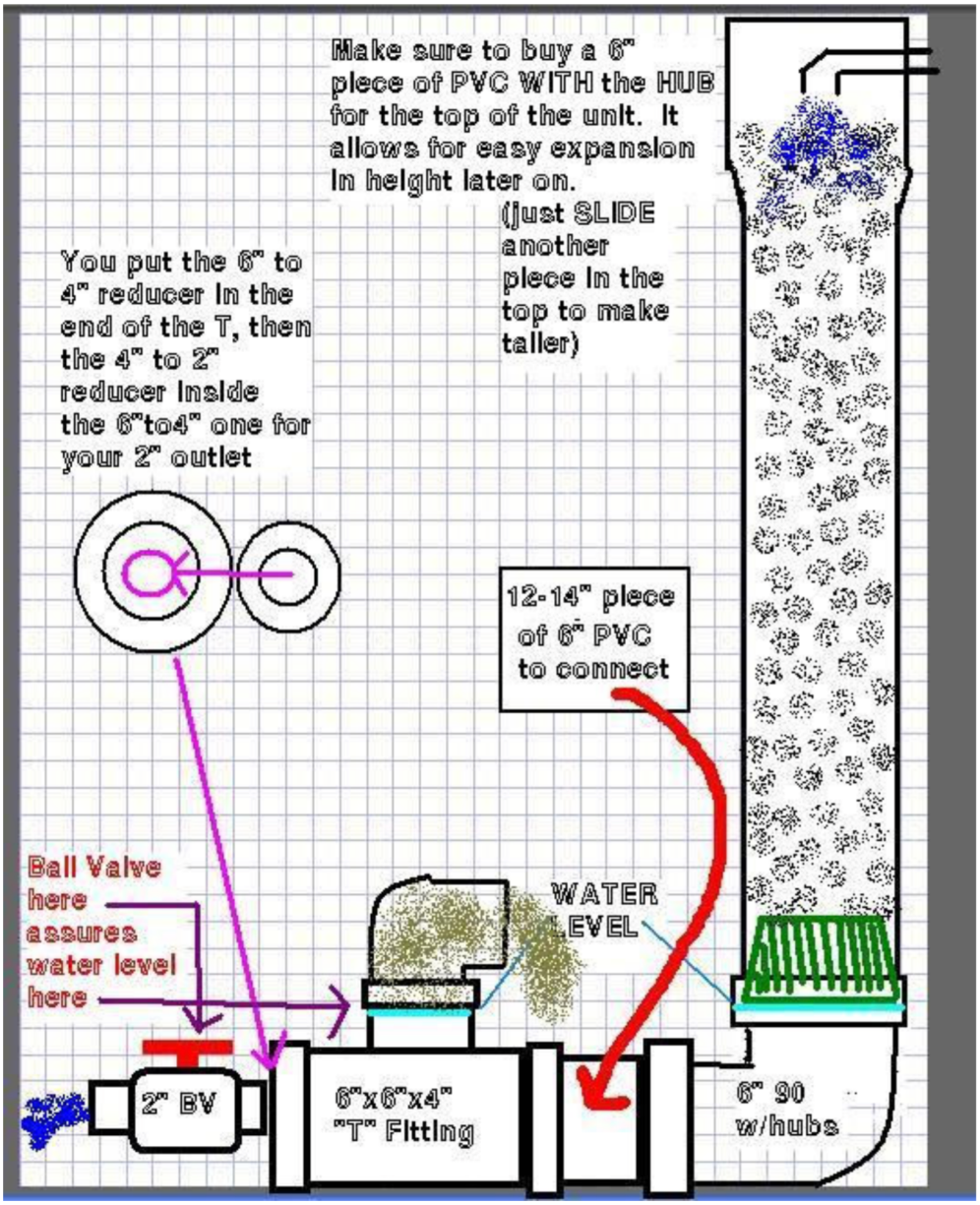
Clarity units are available in four difference sizes. The two smaller units can be found for sale in the USA.

Model	Price	Capacity (gallons per hour)	Cost per Gallon of Capacity	Recommend Pond Volume (gallons)	Dimensions (inches)
CL 3	$885	800	$885 / 800 = $1.10 per gallon	800 - 2,700	45” - 27” - 12”
CL 10	$1,250	2,700	$1,250 / 2700 = $0.46 per gallon	2,700 - 8,000	53” - 33.5” - 16”

Clarity video: https://www.youtube.com/watch?v=whHMAK8vhWU

DIY Fractionator

To save a considerable of money, a Do It Yourself (DIY) foam fractionator can be built based on 6” PVC pipe and fittings. Six inch diameter pipe is the largest that can be commonly obtained at Lowes. Home Depot does not carry 6” PVC DWV pipe and fittings. Below is a drawing of a DIY foam fractionator that is built on the same principles of the commercial Clarity units.



ATLANTA KOI CLUB

Note that the components listed below are not a complete match for the items in the previous DIY example drawing. Changes were made to improve performance. The fractionator made for Atlanta Koi Club uses the following components:

- 6” diameter PVC pipe in a 5’ length and a 1’ length
- Atrium grate to keep media in the 5’ length of pipe
- 6” coupling to hold the shower head
- floor drain and street elbow fitting to create the shower head
- around 1 cubic feet of media to fill the 5’ length of pipe
- 6” DWV PVC 90 degree elbow fitting
- 6” DWV PVC Wye fitting to shear the foam off of the passing water
- 6”-4” adapter and 4”-2” adapter to make a 2” exit for the water
- 2” ball valve and short piece of 2” pipe to provide an exit port that can adjust the speed of the water

The following are needed to assembly the fractionator:

- power or manual saw to cut PVC pipe and trim the Atrium grate.
- PVC primer and glue

Fractionator Cost and Performance Comparison

Model	Price	Capacity (gallons per hour)	Cost per Gallon of Capacity	Recommend Pond Volume (gallons)	Dimensions (inches)
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CL 10	$1,250	2,700	$1,250 / 2700 = $0.46 per gallon	2,700 - 8,000	53” - 33.5” - 16”
DIY	$250	1,500 - 1,800	$250 / 1650 = $0.15 per gallon	1,500 - 5,000	75” - 42” - 7”

DIY Fractionator installation

The unit must be attached vertically to a wall, post, or other rigid structure. Secure the unit in place before attempting to add connecting pipework and operating the fractionator. The fractionator must be entirely installed above pond water level so that the water leaving the unit will flow back to the pond via gravity. Keep in mind that the higher the unit is installed, the more work the pump must perform to deliver the desired flow rate to the top of the unit.

The fractionator is designed to work with a water flow rate of 1,500 to 1,800 gallons per hour. The input and output connections are via 2" PVC pipe. A new dedicated water pump can be used or a portion of the flow from an existing pump can be used as the supply. The source water should be passed through mechanical filter stage to be free from organic solids such as feces, lumps of algae, and uneaten food that could be trapped by the media. The unit and connecting pipes may be painted using a paint that is made for plastics.

If there are DOC present in the water, foam will gather in the 4" exit hub of the Wye fitting. The foam will rise and slowing pour out of the Wye fitting 4" hub. As an option you can insert a 4" DWV PVC street 90 degree elbow into the 4" hub to direct the foam to the desired location. Dispose of the foam as you like; just don't let it back into the pond.