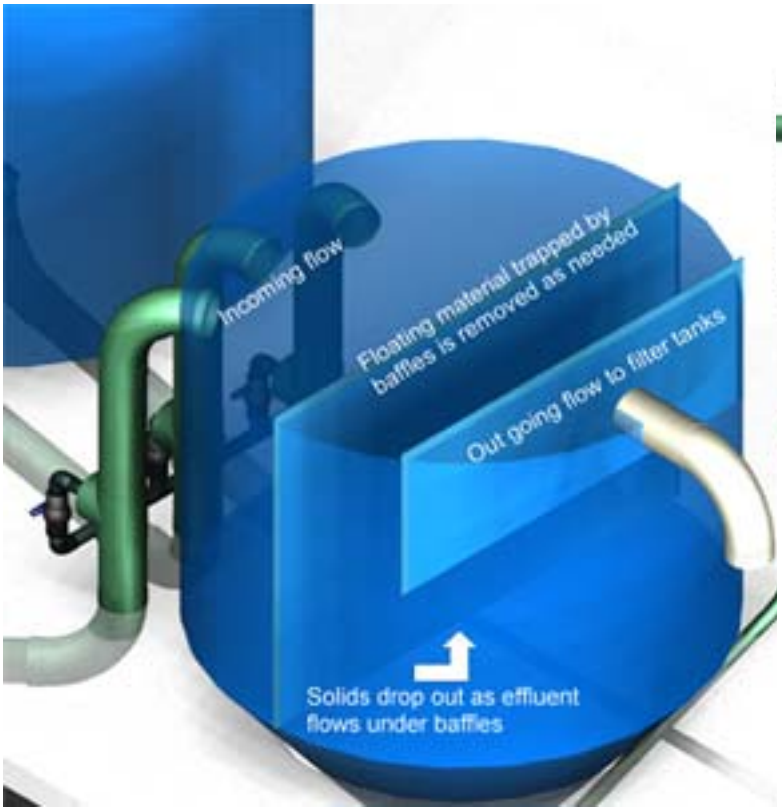
Aquaponic Equipment

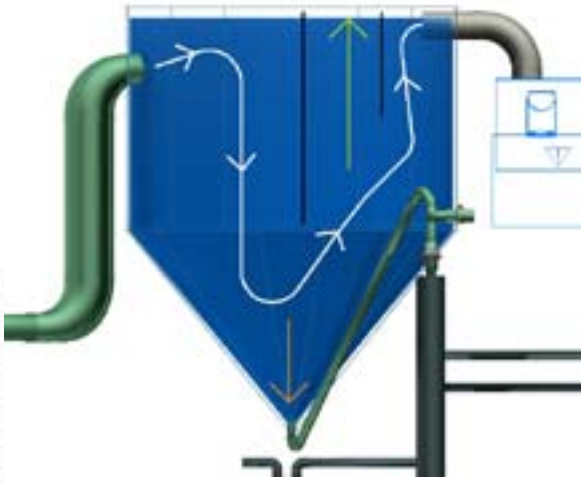
The Clarifier

By Rebecca L. Nelson and John S. Pade

This is the first in a series of articles that looks at the individual pieces of equipment used in aquaponics. In this article, we discuss clarifiers, also known as solids filters or mechanical filters. A clarifier is simply a unit that separates and removes the settleable solid fish waste and particulate matter in the water.

Of the three main types of aquaponic systems...raft, NFT and media filled beds...a clarifier is required in the first two - raft and NFT. In a media filled bed, all of the solids remain in the system and are broken down in the media. Removing the solids in raft and NFT culture allows a grower to stock the fish tanks more densely, resulting in higher production of both fish and vegetables. The solids that have been removed can be composted or dried and utilized to fertilize soil in traditional farming.





Conical Clarifier Design

Left: Cut-away view shows the incoming and exiting water and baffles.

Above: Water flow: The black lines in the clarifier are the baffles that direct and slow the water. The white arrow show the flow of the water. As the water slows and goes around the first baffle, the heavy solids drop down to the bottom of the cone (orange arrow). The clear water continues past the baffle and rises toward the exit pipe. The green arrow depicts the material that floats and catches behind the second baffle. The water leaving the clarifier flows into the biofilter tanks.

In aquaculture, mechanical filtration and biofiltration are very distinct and separate processes, and they must be treated as such. Mechanical filtration is the removal of solid waste, whereas biofiltration is the biological process that converts toxic nitrogenous wastes to non-toxic nitrate. We will discuss biofiltration and biofilters in detail in a separate article.

Solid waste is typically categorized by its size and specific gravity. Settleable solids are those solids which have a relatively high specific gravity compared to the water in which they exist. They will settle to the bottom. Suspended solids are those in a category that have a specific gravity the same as, or slightly higher than, the water. The suspended solids can be trapped in the first step of biofiltration, where they remain in the water and are converted into minerals available to the plants.

In an aquaponic system, water is drawn from the bottom of the fish tank and flows into the clarifier. As the water passes through the clarifier, the settleable solids drop down and can be collected.

Since it is advantageous to allow the suspended solids to remain in the system for a period of time, while the waste is converted to valuable elements and trace minerals, most aquaponic system designs do not usually incorporate equipment to immediately remove the suspended solids.

In aquaponics, there are two typical styles of clarifier, a conical design and a settling basin. The UVI (University of the Virgin Islands) system utilizes a conical clarifier, which has proven to be very effective. Some smaller systems use a settling basin. The idea of both designs is the same, to allow the solids to settle out of the water column, where they can be easily removed.

In a conical filter, the waste-laden water enters the top of the filter. It is forced down, by a baffle or series of baffles and, as it rises around the baffle, the solids fall to the bottom of the cone. To completely remove the solids, a valve at the base of the filter is opened and the filter is emptied, quickly and efficiently removing the fish waste and uneaten fish food.

A settling basin is a flat tray, usually only a few inches deep and a couple of feet long, depending on the overall size of the system. The water enters one end and exits the other. As the water enters the tray, there is a deeper basin where the large solids settle. At the bottom of this basin, there is a drain valve, which is opened periodically to flush the solids out. Beyond the deeper basin, the water moves forward and finer solids settle out. Just before the exit end is a weir, or dam, that the water must flow over. Most of the remaining solids drop behind the weir. The water exits after the weir and then flows to a biofilter or back to the fish tank, depending on the design of the system.

Other variations of solids filters used in aquaponics include swirl separators and settling tanks with catch basins in the bottom.

Solids capture is one of the most important processes in a recirculating raft or NFT aquaponic system. If solids are not effectively removed, you will have problems with waste build-up which will cause toxicities in the water, the plumbing will become clogged with waste and the plant roots will become coated with fine solids which reduces the plants abilities to uptake the nutrients.

One of the most critical factors in designing a clarifier for your system is the size and required rate of water flow. The flow rate has to be fast enough to meet circulation requirements of the system and yet slow enough to allow the solids to settle out. Turbulence in the clarifier is not desirable because it will cause the solids to break into fine suspended solids which remain in the water column.

About the Authors: *Rebecca L. Nelson and John S. Pade are the publisher of the Aquaponics Journal and consultants in aquaponics, hydroponics and controlled environment agriculture. They can be reached at 608-297-8708 or by email at info@aquaponics.com*