

Undergravel Filters

Undergravel filters still have their place in the hobby.

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Not all cichlids are aggressive diggers. The dwarf flag cichlid (*Laetacara curviceps*) is one that can coexist with an undergravel setup.

In the early 1980s, I decided to set up a community tank using a 36-inch-long aquarium placed on a metal frame. I wanted to set it up without too much of an outlay on equipment. The intention was to have the aquarium lightly stocked, with a pair of *Laetacara curviceps* for the bottom and a few small shoals for midwater and top.

At my local fish outlet, I considered the options for providing adequate filtration for the tank. In those days, the options consisted of an internal box filter or an undergravel filter powered by an airline or the external canister filter.

The canister filter was rather expensive in those days, occupied a lot of space outside the tank and looked unsightly if it was not housed in a cabinet. The box filter occupied space inside the tank, while the undergravel filter disappeared from view under the gravel and didn't cost a lot.

There were two ways to operate the undergravel filter. The first option was to use air bubbles produced by an air pump to lift water via the uplift tube of the filter. This caused minimum disruption in the aquarium with just a gentle flow of water. The other, then newer, option was to use a powerhead to raise the water in the uplift tube. This gave a greater circulation of water and a strong current in the aquarium. Wanting just a gentle circulation of water in the tank, particularly as I was hoping to get the *L. curviceps* to breed, I opted for the undergravel filter with air circulation.

Undergravel It Is

I returned with the undergravel filter, an air pump, airline and diffuser, as well as enough gravel to provide a 3-inch-deep bed. The filter was placed on the aquarium floor and the well-washed gravel placed on top. The tank was carefully filled with tap water and the aquarium planted with realistic-looking plastic plants. The heater thermostat was set at about 75 degrees Fahrenheit, and the whole setup was stabilized for a week.

Just Add Fish

At the fish outlet, I considered what fish to buy for this tank. They had to be hardy and active fish. Zebra danios fit this description, and I came away with six of them. The zebra danios quickly settled into the aquarium and seemed to revel in the large, almost-empty aquarium. A week later, on another visit to my favorite shop, I came away with four harlequin rasboras and four small tiger barbs. These quickly settled in the aquarium, and I was really pleased with all the activity in the tank. All these shoaling fish got on well, mainly keeping their attentions to their own kind. The fish were fed sparingly with a good-quality flake and occasionally with some live *Daphnia* or bloodworms.

A month after first setting up, I picked up a male and female *L. curviceps* with the help of the store manager, who was able to spot the differences in the sexes. When the cichlids were added to the tank, the shoaling fish were initially wary of the larger newcomers but soon learned that they were in fact rather peaceful. The cichlids also greedily ate flake food, but now the fish were occasionally given some live *Daphnia* or bloodworm, which they all seemed to enjoy. The fish were given enough food that they could eat within five minutes so that no uneaten food ever accumulated on the tank bottom.

Good Schoolers

These schooling fish are perfect for community setups. They get along well with other species and are easy on equipment, plants and decorations. While tiger barbs are known to be fin nippers, this problem is easily solved by keeping them in a community with other active fish.

Zebra danio (*Danio rerio*)

Tiger barb (*Puntius tetrazona*)

Harlequin rasboras (*Trigonostigma heteromorpha*)

Undergravel Underworld

Now with the full load of fish that were intended for this aquarium, the undergravel filter was coping well. All the fish feces was being sucked into the gravel and did not remain on top. Here the nitrifying bacteria did their job and broke down nitrogenous wastes first to ammonia, then nitrites and finally nitrates. With no live plants in the aquarium, nitrates accumulated in the water. Twenty-percent water changes were carried out every three or four weeks with the help of tubing attached to a wide pipe. This allowed me to siphon water out of the tank while removing some debris accumulated in the gravel.

About six months after setting up this community aquarium, I took a look at the underside of the aquarium to check on accumulation of detritus. This was easily done as the aquarium sat on a metal frame. I was surprised to see a fair number of creatures moving about under the undergravel filter. Closer observation showed them to be small fish.

How was I to get these out without dismantling the whole aquarium? This was managed by using a wide-bore pipe fitted snugly into the uplift tube of the filter and siphoning about 50 percent of the aquarium water out into a bucket. Prior to the siphoning, the small fish were shepherded toward the outlet tube.

The exercise proved successful and about a dozen small fish were recovered and placed in a small aquarium. They turned out to be tiger barb fry, which did well in their new home.

Healthy egg-scattering fish spawn regularly in the aquarium. Most of the eggs tend to be eaten by the residents of the aquarium. But in this case some of the fertilized eggs that got sucked through the gravel survived injury and developed into fry!

Cichlid Undertakers

In another aquarium setup, a powerhead was used to run an undergravel filter in a 3-foot-long tank that was being used as a grow-out tank for Malawi cichlid fry. The powerhead was used because greater circulation and a water current were needed in this tank that held a few fish.

In spite of a high bioload, the undergravel filter performed well because of the increased circulation helped by 30 percent weekly water changes. In fact, it was so successful that within a few weeks the cichlids were large enough to distribute to others. I did retain a dozen of them though. Once these cichlids reached 3-inch sizes their natures changed. The six males dug pits in the gravel all the way to the filter plate while trying to attract female fish to spawn. It was very interesting to watch all this hyperactivity, but the undergravel filter with a disrupted filter bed no longer worked efficiently. I had to remove it and install an outside canister filter to restore efficient filtration.

How They Work

The undergravel filter consists of a plastic grate found in a range of standard sizes that sit on the glass bottom of the aquarium. The plastic grate has a vertical uplift tube where an airline or a powerhead can sit to raise water from under the grate to the water surface. Optimally, at least a 3-inch bed of medium-grain gravel (0.2 to 0.3 of an inch) is placed over the filter plates. If the gravel is any finer, it may fall through the plastic grid. Moreover, because the gravel bed, apart from being a biological filter that acts as a mechanical filter, would clog up quickly with feces and uneaten food if made of fine gravel.

Dissolved waste products from fish urine, such as ammonia in the water that circulates through the gravel bed, feed the colonies of bacteria that build up in the gravel. Nitrosomonas bacteria oxidize ammonia — which is dangerous at levels as low as 2 ppm — to nitrite, which is also toxic to fish. Nitrobacter bacteria convert the nitrite to nitrate, which is much less toxic.

For the undergravel filter to work efficiently, water needs to be pulled through the whole gravel bed at a rate sufficient for the bacteria to do their job. The water turnover required to circulate through the undergravel filter (gallons per hour) to adequately remove waste products from the tank water would depend on the size of the tank, the number of fish in the tank and the fish-feeding regimen.

Water parameters should be routinely tested using kits to ensure that the water contains no ammonia or nitrites. The water flow through the filter is increased if these are present in the water. Nitrates are not broken down further but may be utilized by any live plants in the aquarium, if these are present. The best way to remove nitrates from the aquarium is by regular partial water changes. Vacuuming the gravel at the same time will remove some of the detritus accumulating in the

gravel bed.

Things Can Go Wrong

For the undergravel filter to work, the plates need to be evenly covered with gravel. If there are any breaks in the gravel (where cichlids dig all the way to the filter plates, for example), then water will just go down the exposed area and not percolate through the gravel bed.

Under such circumstances the undergravel filter stops functioning and is virtually useless. In fact, it could become dangerous if left in this state, because with reduced amounts of oxygen the bacteria would break down waste products anaerobically into toxic compounds such as hydrogen sulphide. There could also be a bacteria die-off leading to further deterioration in water quality.

Under these circumstances, switching to another filtration system would be advisable. However, the undergravel filter can't just be turned off and left in the aquarium, but would need to be removed and the gravel thoroughly cleared of debris.

Live plants rooted in the gravel of a tank with undergravel filtration don't do particularly well. This may be because plants don't like fast circulating water around their roots. One option is to place live plants in shallow terra-cotta pots filled with gravel. You can also use plants, such as Java fern or Anubias species, that are rooted on bogwood and placed on the gravel. Artificial plants can also be used.

Final Remarks

The undergravel filter works best in aquariums that contain small fish that do not disturb the gravel layer. In such setups this filtration method offers a cheap and efficient method of providing good-quality water low in ammonia and nitrites.

Reducing debris in the gravel is easily done during water changes by using a large-headed tube attached to a narrower siphon tube. The larger-headed tube is poked into the gravel and allows debris to be removed, while the heavier gravel falls back to the bottom of the tank. The undergravel filter does have a place in the tropical fish hobby.