The Ecosystem Filtration System

by Mike Paletta (Aquarium Fish, Nov. 1997)

Over the years in the reef aquarium hobby numerous individuals have come to be associated with the development of various reef technologies. Examples of this include Lee Chin Eng (1961) with the "natural system," George Smit (1986) with the "Dutch mini-reef," Dietrich Stber (1992) with the "Berlin system," Dr. Jean Jaubert with the "Jaubert system" (Frakes !995) and Dr. Walter Adey with the "algal turf scrubber system").

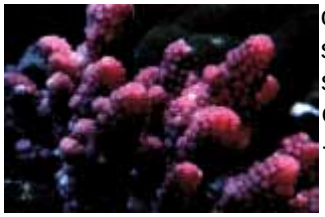
I recently had the opportunity to review a methodology that successfully uses and hybridizes techniques from all these other systems in a completely unique manner that I have never seen before. This may be time to add another name to the list - the name is Leng Sy, and his system is called the "Ecosystem Method" (patent number 5054424). I know some of you have heard a lot of this before, and the term "snake oil" immediately comes to mink. I, too, must admit to having been as skeptical as anyone when Leng gave me a very brief description of his system over the phone.

I have seen more than 300 reef tanks set up with just about every method over known - from systems using undergravel filters to beautiful Berlin displays. So, my original assumption before actually seeing any of Leng's tanks running with his system was that it was probably just a slightly modified Jaubert of algal turf scrubber system. I was still skeptical when I first set eyes on his system and could not detect andy method of filtration.

Upon first viewing his tanks, my initial reaction was that these were simply meticulously maintained Berlin tanks. Bright lights over absolutely crystal clear water revealed a lot of really healthy, growing corals in each tank.

On closer inspection, one factor stood out more than any other: the polyp extension of the corals was absolutely phenomenal. Leather corals had polyps that were extended well over 2 inches, and the branches of a Sinularia looked like a cat's paw because its polyps were so furry. But, the clincher for me was a colony of Stylophora Postillata - I had a fragment from the same original colony. In my tank, the polyps of the colony were extended a couple of millimeters giving it a fuzzy appearance like sandpaper. In Leng's tank the polyp extension was so great I could not tell that this was the same coral that was in my tank. The polyp extension in this Stylophora was the greatest I had ever seen in a Stylophora.

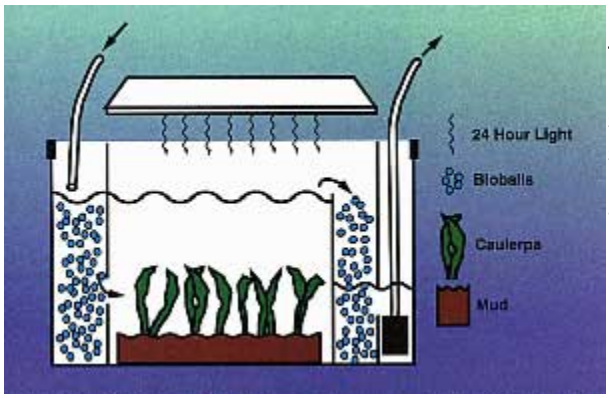
This same maximum polyp extension occurred in virtually every small-polyped stony (SPS) corals in the tank, as well as every nearby tank that was run in the same manner, but on a different What this indicated to me - in addition to the sheer amount of these corals were doing on the rocks and their overall appearance these were extremely healthy tanks.



colony of soft coral in a system. encrusting - was that

Once I was convinced that there was indeed something different about these tanks and this system, I sat down with Leng for eight hours and discussed virtually every aspect of the Ecosystem methodology. Lend considers himself to be a lazy aquarist, but he has been perfecting this system for over six years. As I discuss the details of this system, it will become apparent that some of the techniques have been used in the past. However, Leng has made many modifications to these techniques that make his method unique.

Leng's overall goal was to allow his corals to thrive, while at the same time making the system as uncomplicated and easy to maintain as possible. Very little gadgetry is involved, so there is little need for adjustments of any kind - nor can many things fail. In addition, this system requires very little maintenance, so it takes minimal time to operate or, for that matter, even set up a tank.



The Ecosystem method basically works in the same manner as most systems. Water is drawn from the surface via an overflow box, from which it flows into a sump. This is where the heart of the Ecosystem method is located. The tank water first flows into a narrow chamber full of bioballs. These balls are submerged, not dry, and they act primarily to break up any large pieces of detritus , as well as to dissipate any large air bubbles that form from the water splashing down. The water then flows out through two outlet slots near the bottom of a partition and into the main filtration chamber.

This central chamber is where virtually all of the filtration occurs. It contains two separate components that work in combination with each other. In the bottom of the chamber, running from front to back, are numerous 1- inch-partitions. Resting between these partitions is Leng's special "mud" substrate - Miracle Mud.

This mud is the crucial component that Leng has been working on throughout the development of his system. It is a non-calcareous media that looks like a thick brown sludge. To the touch it feels like an extremely fine silt, and appeared to be slightly buoyant in that it did not pack down. This slightly buoyant property ensures that the mud is anoxic - low in oxygen.

Leng noted that initially, when he first set up this system, the mud was unpopulated by digging organisms. When viewed after several years of use, however, this was no longer the case. The mud was full of worms copepods, nematodes and so on, which had populated it from the live rock.

He also told me that over the years he had tried numerous types of mud, but that the formulation he was now using seemed to be the crucial element in the system. He felt that this media performed many functions, which I will elaborate below.

Perched above the mud in this chamber is a large bed of Caulerpa sertuloides. Many of you who have read previous articles know of my general disdain for algae in reef tanks, and my opinion that algal turf scrubbers are not the optimal method for filtering a closed reef system. The reason for these conclusions is that in the past when algal scrubbers were used for filtering reef tanks, several problems invariably arose.

First, turf algae has a tendency to overgrow the tank as it moves from the scrubber to the tank over time. Second, in most tanks I have seen that use algal scrubbers, the algae released yellowing compounds into the water that not only reduced the penetration of light but also seem to produce negative effects on the corals, particularly SPS corals.

Also, some of the tanks I've observed that have algal filtration exhibit pH values that fluctuate widely from night to day because of the algae releasing or consuming carbon dioxide. For this reason many new algal filtration systems recommend lighting the algae tank in reverse of the way the main tank is illuminated. Additionally, in some tanks with high algal loads the algae outcompete the corals for some of the trace elements in the water.

And lastly, in most turf scrubber systems it is necessary to frequently remove the algae in order to rid the tank of excess nutrients, which is often a labor-and time-intensive endeavor.

So, having giving you all these negative aspects about algal filtration, why am I so positive about this system, which uses algae as one of the two components of filtration? To begin with, this algal bed in the sump is illuminated 24 hours a day with four fluorescent tubes - the lights above the sump never go off. This has caused some interesting results.

First, the wild pH fluctuations I have seen in other systems do not occur in this system. The pH bottoms out at 8.2 one hour prior to the lights being turned on in the main tank, and it rises to a maximum of 8.4 one hour before the light in the main tank going off at night.

Also, after several years of growth in each system, the culerpa in the filters has never crashed and gone into sexual reproduction. As a result, none of it has bound its way into his main tank, which has been a problem in some other algae filtration systems. This may also be a function of the species of Caulerpa that Leng has chosen. C. sertuloides is a rather sturdy type of Caulerpa.

Even more interesting is how crystal clear the water is. Many of the reef tanks I've observed that contained even small amounts of algae also had water with a distinct yellow tint. The absence of this yellowing in Leng's tanks may be a result of the 24-hour light cycle. Without a dark cycle, the production of gelvin (yellowing compounds) - thought to be a product of algae chloroplasts breaking down at night and being released into the water - may be prevented.

Lastly, for reasons still unclear to me, this algae has never outgrown the filter and needed to be harvested or removed. So, from what I saw, little maintenance is involved in running this system.

Once the water passes through the Caulerpa it flows over a partition, through slots near the bottom of a second partition, and into a chamber containing bioballs, from where it is pumped into the main tank. These last bioballs prohibit Caulerpa from being drawn into the pump and fed into the main tank. The amount of water flowing through the filter is approximately three to 10 times the tanks volume per hour.

All this may not sound like anything revolutionary, but upon seeing the tank and the corals, and also the fish, I do indeed believe that this represents another methodology for successful reef husbandry. I was particularly impressed that not only were the corals thriving, but so were the fish.

In this system, all of the fish had colors as vibrant as the day they were collected, even though many of the tanks inhabitants have now been in the tanks for six years or longer. In addition, incidents of ongoing lateral line disease have been reduced and even eliminated, and color has seemingly been restored in fish that had faded over time (more on this later in the article).

Besides the overall health of the inhabitants, there are other advantages to this system as well. In terms of maintenance, these tanks require less effort than just about any other system I've seen. These tanks have bare bottoms in order to easily remove the detritus that settles out during the week. Once a week Leng siphons out 10 gallons of water to remove as much detritus as possible.

To further reduce the detritus buildup, the current in these tanks is quite high. In the 400-gallon SPS tank there are periods and circulation pumps producing over 4000 gallons per hour of circulation, which keeps detritus in suspension so it can find its way to the filter. No doubt, this strong water movement also helps to explain why the corals are growing so exuberantly, and there is great polyp extension. In the 120-gallon soft coral tank the water circulation is approximately 1500 gallons per hour.

Other than removing detritus weekly, the only other maintenance that is performed on this system s additions of calcium, in the form of calcium hydroxide, and buffer. These are done to maintain a calcium level of more than 400 parts per million (ppm) and alkalinity above 2.5 milliequivalents. Other than this the system virtually runs itself. To date neither iodine nor strontium have been added, and no deleterious effects on the corals are evident.

Combining the Caulerpa with the mud has also created a system in which there are virtually no nutrients that encourage micro algae growth. During a daily two-month testing period, ammonia, nitrite and nitrate remained at 0 ppm, while phosphate showed only a trace - 0.1 ppm. These low numbers are in spite of the fact that the tanks have high fish and invertebrate loads and they are all being fed.

After reviewing this system again and again, the question arises, "How does this system work, and why does it work so well?" Many of us have tried the Jaubert system, with mixed results, as well as the algal turf scrubber, with less than optimal results, The results from using this system seem to be much better.

As already noted, the mud that Leng has developed seems to have some very unique properties. It may help to prevent Caulerpa from crashing, and it may remove the organics released by the Caulerpa before they reach the main tank. Whatever the effects, this system would not work without the mud.

Because there is no skimmer or other form of chemical filtration, this system may allow iodine to be recirculated by the Caulerpa, so none needs to be added. Which may explain why the Xenia colonies are thriving and have never shown any evidence of meltdown observed in numerous tanks over the years, even though no iodine is added. The lack of a protein skimmer may also allow plankton to develop in the tank.

One thing that I did notice is this tank is that there was a significant amount of particulate matter in the water. This may have been plankton and could also factor into why the corals were doing so well. It could be that plankton is an additional source of nutrition lacking in tanks with protein skimmers. Unfortunately, I did not have the time or equipment to determine if this was indeed the case.