

ROY MEEKE

The Plenum System



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is well-known to many marine hobbyists through his connections with the West Yorkshire Marine Aquarists Group.

In his spare time he can be found perched on his stool behind the counter at **UK Marines** surveying his empire and readily giving out advice and information to his thousands of customers.

There is currently a great deal of debate as to the best ways of filtering marine systems – some of which have caused much heated arguments between the various schools of thought and proponents of different methods. Some of the arguments, I suspect, are of a commercial origin – the method doesn't fit in with what a manufacturer wants to sell you, especially with the latest trends towards more natural systems i.e. deep sand beds, mud and plenum systems where the more traditional trickle, internal, canister and fluidised bed filters etc etc are not required. There is also the inevitable scare stories based on mis-information and ignorance – not least of which has been especially applied to the plenum system.

Now before I go any further, although I personally prefer the plenum system, I realise there are "many ways to Rome" and I know of many people with superb systems

using other methods and it is not in the remit of this article to go automatically knocking them. I feel that many failures, no matter what the type of filtration chosen, is not necessarily the fault of that particular type of filtration but more the failure of correct application, construction and maintenance. However, out of all the "newer" more natural systems it is at least as good or even better but more importantly I do think it is also the easiest one for the beginner or less experienced aquarist to get right and will serve them well as they struggle with all the other problems they need to learn about such as compatibility, disease, lighting, water parameters – ad infinitum.

Some articles that I have read by anti-plenumists explain how to build a plenum and then proceed to tell you why it doesn't work both theoretically and practically (although having read some of the

construction methods proposed I am not surprised – frankly some are laughable). There are some hobbyists who have tried and failed and others who have had less than expected results. Some have done it slightly differently to me and had excellent results. All I can say is that the way I have done it has worked for me and the many scores of my customers and friends (some of whom were potentially hair algae suicidalists with past methods!). Over the years I have had many telephone conversations, e-mails etc with Bob Goemans, the man who adapted and refined the plenum system for the hobbyist from the theories of Jaubert, and have used the methods that he told to me.

Overview/General Information

What is a plenum system? Basically, it's a 4" deep sand bed with a small gap underneath (1" – 1 1/2") which is called the plenum and in which the oxygen levels gradually decrease with depth through the sand. However, because of the gap it never becomes totally without oxygen (anaerobic) – this condition has come to be known as anoxic (low levels of oxygen) and the microbes that live in this area are very efficient at removing nitrates which they use as an energy source reducing them back to nitrogen gas. The plenum system recycles nutrients whereas other systems tend to go towards storage of nutrients which could result in an algae problem. No water is pumped mechanically up or down through the sand but is merely passed across the surface of it. The system works by diffusion and chemical, thermal and nutrient flux and the attraction between the positive charge in the bulk water and the increasingly negative charge in the sand bed, but because the plenum contains a small amount of oxygen there is a slightly less negative charge than in the bottom



This massive 16ft x 4ft plenum filter can be found at UK Marines

sand above it, it sends oxidised elements back up to the bulk water therefore recycling rather than storing nutrients. Much has also been made by both pro and anti-plenumists about the need for benthic invertebrates e.g. copepods, amphipods, other crustaceans, tiny brittle stars, worms and shrimps etc. However, desirable and fascinating as these creatures may be I have found that their presence is not actually necessary in a plenum as far as nitrate reduction is concerned. Some say that they turn the sand over and stop it binding – but I have never come across this binding except in cases of over-use of kalkwasser causing calcite to form, binding the grains of sand and then it would be questionable whether these creatures were strong enough or in sufficient numbers to prevent this anyway. To qualify my comments on these creatures usefulness, I have set up fish-only systems using remote plenums not in direct contact with the fish where the sand was new and sterile, matured by liquid bacteria, no live rock or corals with rock bases have ever been introduced from which the creatures could have crawled into the sand and many months down the line when the system was heavily stocked with well-fed fish upon inspection of the sand there

Display tank at Oasis Aquarium complete with plenum filter

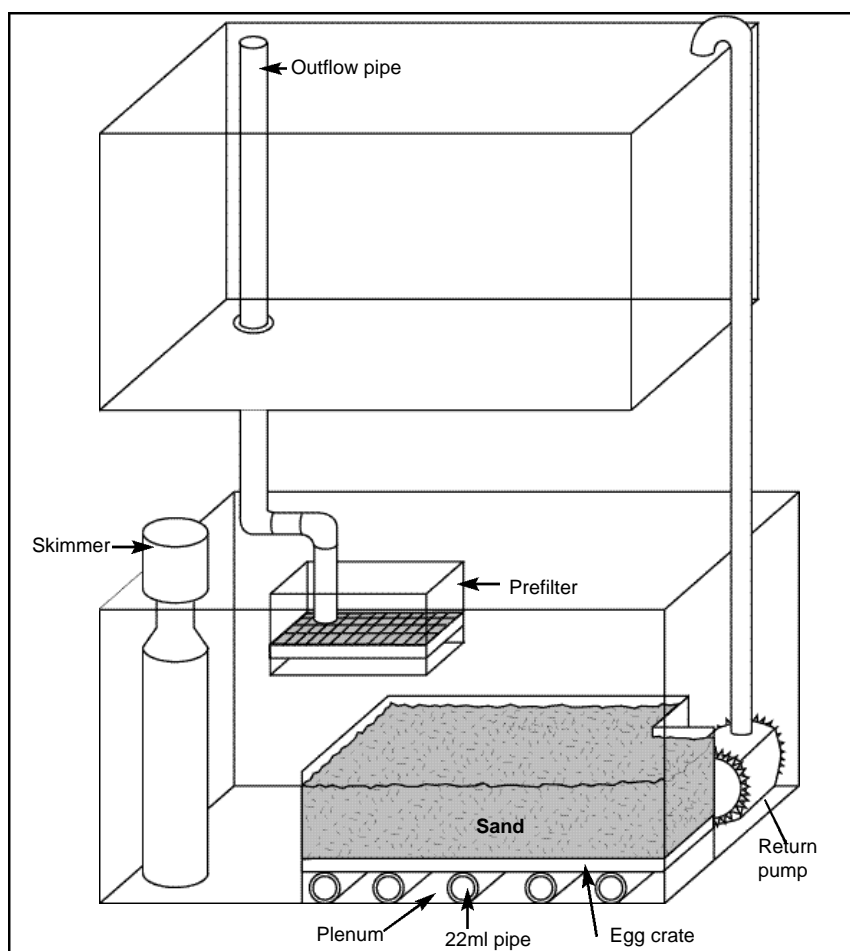


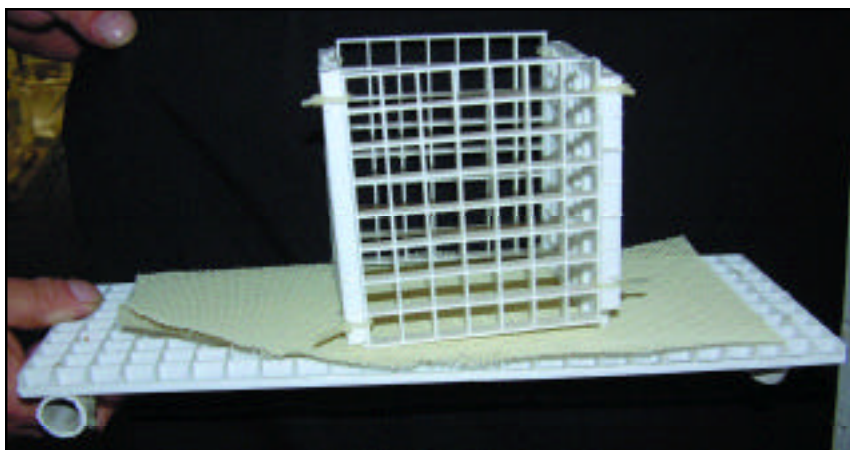
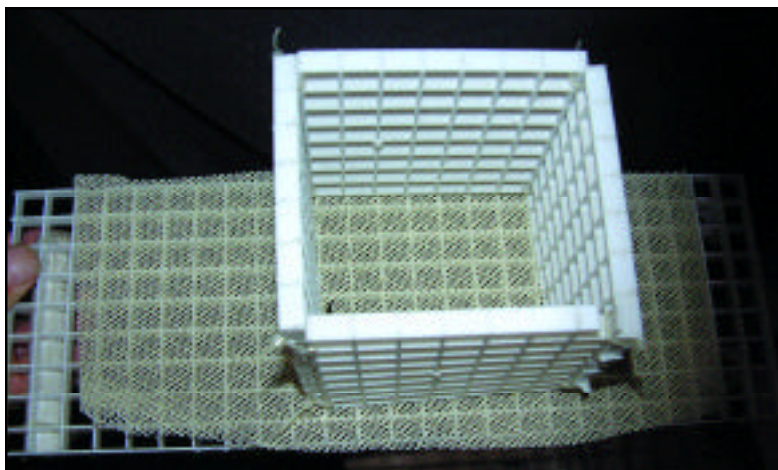
appeared to be no sign of them. The nitrates were very low (approx. $\frac{2}{3}$ ppm) indeed not much higher than a comparatively very low stocked invert plenum system whose sand was teeming with tiny creatures. I am therefore convinced that the plenum system

works almost totally on the microbial level. These tiny creatures may in a small way be advantageous such as adding to the plankton count with their breeding activities etc or even holding in suspension and recycling back and forwards nutrients, but the point I am making is that you don't have to worry whether or not you have enough of them to successfully run a plenum system.

Although plenums will work very well in an aquarium I think they are even better in a sump – mainly from a maintenance aspect. In a sump the water can be first prefiltered, then skimmed before passing over the sand which means that large particulate wastes that could eventually break down into the sand and reduce the efficiency, are kept at bay. One of the main disadvantages of an in-tank plenum is that large parts of the sand will be covered with rock and although eggcrate towers can be made to stand the rock on to stop compression of the sand it is still more difficult to clean and maintain than a sump version.

In a sump plenum the sand part should ideally have at least $\frac{2}{3}$ the base area of the main tank and the main tank must also be drilled to allow water down into the sump. As with any other filter the sand must be regularly cleaned so when you do a water change on an in-tank plenum use a syphon kit (the wide bottle type that will suck up detritus but not sand) but only go down a couple of inches in the sand so as not to disturb the anoxic zone. Concerning cleaning the sump type plenum, it is very difficult to get a syphon going as it is usually at floor level, so unless you are prepared to take up the floorboards and lie on your back in the crawlspace sucking at a





piece of hose, you are better off turning off the main pump, letting the drain-down fill the sump, then stirring up the top layer of sand and either

- pumping out the resulting dirty water into a bucket with a small powerhead thus incorporating it into your water change regime, or
- using an internal power filter filled with filter wool, or
- a combination of both methods depending on if you want to change the whole or just part of the volume of water in your sump.

The power vacuums are not always satisfactory as the detritus tends to be very fine and much just goes straight through the bags.

Construction

Eggcrate (a type of fluorescent light diffuser) is supported on 22ml overflow pipe approximately 5 or 6 inches apart (use the ABS solvent weld type or the hard white pvc – not coloured which may leach

dyes). This pipe should be drilled every few inches to allow water to circulate through it. On top of the eggcrate is placed gravel tidy (this prevents sand dropping through the holes in the eggcrate). 2-4mm coral sand (this size is critical as too fine or too coarse would effect the oxygen gradient) is then placed on the gravel tidy to a depth of 4 inches. If the plenum is going to be in the aquarium then another layer of gravel tidy must be placed about 2 inches deep in the sand to prevent burrowing Gobies etc from digging too deep and disturbing the low oxygen zones.

Well

toxic

that, basically, is it – apart from using the best skimmer you can afford, adequate lighting, reverse osmosis water for your salt mix, maybe some living rock to seed it and although a plenum system is far more efficient in the use of phosphorous than others you may still get a little phosphate which can easily be removed with the use of products such as **RowaPhos**.

One other point to remember is that it usually takes about three months before there is sufficient numbers of denitrifying bacteria established in the lower zones and the plenum properly “kicks” in as far as rapid and efficient nitrate reduction is concerned so you will probably have to go through to some extent initially, the different algae stages i.e. brown diatom, green, red slime or even hair algae as can happen with other methods. At this point the use of **RowaPhos** can be extremely beneficial, not just to plenums but any other form of filtration, as I have found that you can have high levels of phosphate but no nitrate or vice versa and have no nuisance algae – but just a small amount of both and you could have a major algae problem. This can happen at any stage in a tank’s life so continued use of **RowaPhos** is recommended. Remember, medium/high nitrate levels are not conducive to both long-term fish and invertebrate health so just chucking **RowaPhos** into another type of filtration to remove algae does not, in any way, negate the importance of the nitrate reduction so efficiently achieved by a plenum system.

In conclusion I have used and abused plenums way past what the normal hobbyist would and they have still come up trumps – so if you want an algae and nutrient-free system with healthy happy livestock ignore the misinformation – they don’t crash if they are built and maintained right – and join the very many of us who have had unparalleled success with plenums.

